THE PLANT DISEASE REPORTER

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Section of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

THE PLANT DISEASE REPORTER

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THE PLANT DISEASE SURVEY
SECTION OF MYCOLOGY AND DISEASE SURVEY

Horticultural Crops Branch — Plant Industry Station, Beltsville, Maryland
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INCITE, INCITANT, INCITEMENT

E. S. Luttrell

The terms "incite" and "incitant" have recently appeared in the literature on plant diseases in place of "cause". There seems to be a growing tendency toward uncritical acceptance of these newer, more pretentious terms by plant pathologists, apparently on the assumption that they are more exact than the generally used word "cause". Before pathologists are further divided on terminology it would be well to examine the advantages to be derived from the use of "incite" and "incitant". These new terms should be accepted only after some demonstration that "cause" is inadequate and that "incite" and "incitant" are the best possible replacements.

The objection to the use of "cause" in referring to a specific pathogen associated with a disease seems to be that it implies that this pathogen is the sole cause of the disease and ignores predisposing factors. Actually, "cause" is used with the clear understanding that the pathogen referred to is only the immediate, and usually inadequate, cause of a particular effect on plant condition, the expression of the disease being determined in part by the hereditary degree of susceptibility of the host and the environment in which it has grown, the hereditary virulence of the pathogen, environmental factors affecting the production and distribution of inoculum, and the conditions under which the disease develops. "Cause" is in general use with the same meaning and limitations that it has in plant pathology. "Incite" is a less familiar word which requires some extension of meaning if it is to be used in referring to plant diseases. Although its meaning may be determined from the context, its use may confuse the farmer, if not the pathologist. "Incite" has no advantage over "cause" in obviating the assumption that the pathogen referred to is the sole cause of the disease. It may have the advantage of emphasizing the physiological response of the plant. This advantage is real only if disease is defined as a series of abnormal physiological reactions by the plant. However, disease, as defined and as commonly used, refers to a condition. Although the "cause" may "incite" the plant to physiological responses which result in a diseased condition, it is no more necessary to replace "cause" with "incitant" than to replace "disease" with "incitement". Words other than "incite" might be considered. "Induce" is already in use in medicine and physics with an extension of meaning similar to that now proposed for incite. "Precipitate" could be defended, especially for diseases which appear only when the host becomes senescent or is weakened by adverse growing conditions.

The use of these terms may be compared by applying them in discussions of a few representative diseases. In loose smut of barley, for example, favorable temperatures and humidity at flowering time are necessary for infection of the ovules by Ustilago nuda. However, normal weather conditions in many regions are such that infection depends almost entirely on the presence of inoculum. Although the fungus might be said to "incite" the plant to earlier production of heads, the major effect is destruction of the grain. This appears to be a relatively simple cause and effect relationship. There seems to be no valid objection to referring to U. nuda as the "cause" of loose smut.

Although late blight of potato occurs only when Phytophthora infestans is present, the develment of this disease is so dependent on other factors that epidemics may be predicted on the basis of weather conditions. P. infestans may be said to "cause" late blight with the reservation that conditions favorable to the multiplication, spread, and establishment of this fungus must occur. The major symptom is necrosis. It seems more appropriate to say that this necrosis is "caused", rather than "incited", by P. infestans. It may be possible to consider some stimulated activity of a plant, such as increased growth resulting in gall formation, to be "incited" by a pathogen. However, death represents a cessation of activity. Necrosis might be "caused" or "induced". It can not be "incited" unless it is considered to be a type of autolysis such as that occurring in the gills of Coprinus spp. If "incitant" is to be used in this situation, it should be applied to factors of temperature and humidity, which might be said to "incite" the fungus to rapid development. "Induce" would be preferable in place of "incite".

The severity of infection of wheat by Erysiphe graminis is determined in part by weather conditions. Heavy applications of nitrate also increase the severity of the disease. One effect on the host is an increase in rate of respiration. The fungus might be said to "incite" the plant to more rapid respiration. However, the chief effects are reduction in food supplies, death of the older leaves, and lowered yields. It seems more appropriate to say that these effects are "caused" by E. graminis rather than "incited" by this fungus. Excess nitrate might be said to "incite" the wheat to a lush type of growth which renders it more susceptible, or to "induce" such growth in wheat. The term "incitant" in this case should be applied to the nitrate.

A Cercospora sp. morphologically similar to C. apii has been found associated with a late blight of corn in Georgia. Infection occurs only after the plants become senescent. It results in spotting and die back of the leaves. The fungus is the "cause" of this disease only in the limited sense that, under favorable weather conditions, it hastens the death of leaves and produces a spotting which does not occur in its absence. However, it is hardly proper to say that the fungus "incites" premature death in the leaves. It would be better to say that it "precipitates" death. The only possible use of "incite" in this situation seems to be in referring to the effect of weather conditions on the development of the fungus.

Although "incite", "induce", and "precipitate" may have some uses in discussing plant diseases, none is so generally useful as "cause". None is a suitable replacement for "cause". If "cause" is considered inadequate and some more exact, scientific term is desired, it would be better to invent an entirely new term than to borrow a common word and attempt to modify its meaning.

GEORGIA EXPERIMENT STATION, EXPERIMENT, GEORGIA.

CURLY TOP OF THE POTATO IN UTAH AND ITS POSSIBLE RELATIONSHIP TO "HAYWIRE"

W. S. Gardner[1]

The curly top virus (Ruga verrucosans) disease of potatoes was first reported by Severin (17) from California in 1929, and since by Giddings (9). Potato curly top also has been reported from Oregon (20), Washington (12, 14), British Columbia (20), and Texas (19).

Goss (10) first described potato "haywire" from Nebraska. Jensen and Livingston (11) presented a brief description, and a photograph of "haywire" in Bliss Triumph potato. "Haywire" also has been reported from Texas (19), Louisiana (7), Mississippi (1), Colorado (4), Wyoming (3), Idaho (2), Kansas (20), and from Alberta, Canada (6). In Canada (13) the secondary symptoms of the bunch-top (purple top) disease are reported to resemble "haywire".

A disease of potatoes referred to as "haywire" was observed by Waldee (18) in Iron and Beaver Counties, Utah in 1947 and 1948. During 1949 and 1950, the writer (8) studied this disease in the White Rose variety, and found that it was caused by the sugar beet curly top virus. At the conclusion of the study, it was pointed out that the symptoms of potato curly top as found in Utah were similar to the published accounts of the potato diseases "haywire", green dwarf (15), and purple dwarf (16). Recently Menzies and Giddings (14) established the fact that the curly top virus caused green dwarf.

FIGURE 1. White Rose potato plants on the right grown from tubers collected from plants which showed symptoms of curly top. The curly top plants range from dormant persistent seed pieces to nearly normal appearing plants. The curly top virus was recovered from these plants by grafts to tomato, jimson weed, and Turkish tobacco. Control plants on the left.

With the exception of Texas, curly top of potato has not been found in States from which "haywire" has been reported. It is possible for the vector of curly top to be present in large numbers during years of heavy migrations in parts of all the States mentioned with the exception of Louisiana and Mississippi. "Haywire" was often carried to those States in seed stock from Nebraska (10, 7). "Haywire" has not been reported from the Pacific States where curly top has been identified.

In view of observations and experiments in Utah and comparison of published accounts of "haywire" and curly top, it is suggested that "haywire" is caused by the curly top virus, and has escaped positive identification because of great variation in populations and migrations of the vector, difficulties in transmission of the virus to potatoes, the wide variation in disease symptoms, and the fact that only some of the tubers from a diseased plant carry the virus. Studies in Utah showed that 127 tubers from naturally infected potato plants produced 52 normal plants,

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FIGURE 2. Curly top White Rose showing symptoms of tuber-perpetuated curly top. The plant is dwarfed, erect, and the terminal leaflets are curled upward with marginal and interveinal yellowing.

47 emergent diseased plants, and 28 non-emergent diseased plants.

The symptoms of potato curly top as found in Utah (Figures 1 and 2) are well described by Severin for curly top in California, Milbrath for green dwarf, Menzies and Giddings for curly top in Washington, and by Goss for "haywire".

From the descriptions of potato purple top wilt in the United States, and the bunch top and purple dwarf diseases of potatoes in Canada, it is apparent that other potato virus diseases with symptoms similar to "haywire" have been found in North America. Bonde and Schultz (5) reported that the "haywire" virus was more readily transmitted than the purple top wilt virus, and concluded that the viruses were different. It is probable that "haywire" or other potato diseases with similar symptoms which are reported to be found in areas out of the range of the sugar beet leafhopper are not caused by the curly top virus. However, the virus could be carried to those areas in seed stocks, but no spread would occur. When symptoms of "haywire" are observed in potato fields within the range of the sugar beet leafhopper, curly top should be suspected, and specific transmission tests made.

During the summer of 1953, curly top was found in potato plantings in Tooele County, Utah. The disease appeared in small plots of four varieties, and the percentages of plants showing symptoms of the disease were: White Rose 90, Russet Burbank 39, Bliss Triumph 2, and Irish Cobbler 1. A varietal difference in symptoms was noted, with affected White Rose and Russet Burbank showing a yellowish color on leaf margins, and Bliss Triumph and Irish Cobbler leaves showing a purple coloration when the plants were severely affected. Tests are in progress to determine the percentage of tuber transmission from plants which showed symptoms of curly top.

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THE SPREAD AND INCREASE OF INTERNAL CORK VIRUS OF SWEETPOTATOES IN NORTH CAROLINA

L. W. Nielsen and L. H. Person[1]

The rate of spread of internal cork virus from diseased to healthy plants or from fields of infected plants to fields of disease-free plants is of importance when attempting disease control by using disease-free propagating stock. For insect-transmitted viruses, disease spread is related to the presence and prevalence of inoculum, vector or vectors, and susceptible crop. The purpose of these experiments was to study the spread and increase of internal cork in healthy sweetpotatoes at various locations in North Carolina. Two experiments were performed in which healthy and diseased plants were grown in adjoining plots at three locations. One experiment was started in 1949 and another in 1950, and each extended over two growing seasons. The locations selected for the test plantings were Columbus County, a commercial production area; Wake County, scattered commercial production; and Washington County, little sweetpotato production.

The 1949-1950 Experiment: Plants from healthy and diseased Porto Rico sweetpotatoes were planted in identical tests at the three locations. The diseased and healthy plants were replicated four times and randomized in single-row plots. Their vines intertwined as the growing season advanced. The plots were planted in late June and early July and harvested in early November. The roots from all locations were cured and stored in the same storage house. Fifty roots from each plot were sliced and examined for internal cork lesions the first week of February, 1950.

The remaining roots from "disease-free" plots at each location were combined and bedded separately to produce plants for the 1950 season. These plants and those from diseased roots were again planted at the respective locations. The second crop of roots was cured and stored until March 23, 1951 before being examined for internal cork lesions. The data illustrating the natural spread and increase of internal cork in healthy plants at the three locations for the two years are summarized in Table 1.

Table 1. Infection of healthy sweetpotatoes with internal cork virus when grown with diseased plants at three locations.

Location	Percentage of roots from healthy[a] and diseased plants with internal cork lesions						Location average both years
	1949			1950			
	Diseased	Healthy	Difference	Diseased	Healthy	Difference	
Columbus Co.	40.5	28.5	12.0	66.3	72.9	-6.6	59.1
Wake Co.	61.5	12.0	47.5	89.1	71.9	17.2	52.1
Washington Co.	31.5	4.5	27.0	54.6	40.8	13.8	32.8
L. S. D. 5%			13.9			13.9	8.5

[a] Less than 1 percent of this stock later found to have internal cork lesions.

During the 1949 growing season, the virus spread to healthy plants at all three locations. Most healthy plants became infected in Columbus County. Many roots from diseased plants at all locations failed to develop symptoms. These data were obtained before the relationship between storage temperature and lesion development was established (3), but the data reflect the relative proportion of roots infected with the virus in 1949. Some of the 1949 "healthy" roots bedded from each location were examined for cork lesions on August 11, 1950. The following percentages of roots had lesions: Columbus County, 56.0; Wake County, 32.5; and Washington County 36.8. It is believed that these values more accurately reflect the proportion of healthy plants that became infected in 1949.

The data for 1950 indicate that the virus spread to most of the remaining healthy plants at each location during the second growing season. The fewer roots with lesions from Washington

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County may have resulted, at least in part, from the cooler growing season at that location (1, 2).

The 1950-1951 Experiment: For this test disease-free plants were produced and grown on two farms in Columbus County, and on one farm in Wake County. On one farm in Columbus County only disease-free roots, obtained from two sources, were used for producing plants. This planting was located approximately 1/4 mile from other commercial sweetpotato fields. On the second farm in Columbus County and the Wake County farm both disease-free roots and roots containing different percentages of cork were used as plant sources. Four replicated plots consisting of three diseased and three healthy rows of plants were grown on the Wake County farm, while six row plots were used in Columbus County. From the summary of data, Table 2, it is evident that the virus spread and increased faster in the commercial area, even when disease-free plants were some distance from other sweetpotatoes. In this case, at the end of the first growing season 24 to 36 percent of the roots produced cork symptoms, and after the second season infection had increased to approximately 90 percent. In the Wake County area, the spread of the disease was somewhat slower, especially the first year. However, after the second season 58 percent of the roots from the disease-free seed source were infected.

Table 2. The natural spread and increase of internal cork virus from diseased to healthy Porto Rico sweetpotato plants on three farms.

Location of farm : Condition of original seed	Percentage of roots with internal cork lesions		
	Seed stock	1950 crop	1951 crop
Columbus Co.			
Healthy (Louisiana)	0	36	84
Healthy (California)	0	24	92
Columbus Co.			
Healthy	0	20	92
Diseased	20	28	80
Wake			
Healthy	0	1	58
Diseased	1	2	36

These data and information from other studies and observations demonstrated that the internal cork virus spreads to and increases in healthy plants in the Coastal Plain and Piedmont sections of North Carolina, if a source of inoculum is nearby. This is in agreement with natural spread reported from South Carolina (4). The greater spread in Columbus County in 1949-50 and 1950-51 suggests an accelerated rate of spread of the virus in an area of commercial production. About 90 percent of the commercial Porto Rico potatoes grown in this area in 1949 were infected with internal cork. In 1950 a planting of several acres of cork-free stock was made in Columbus County. When the harvested roots were examined after five months' storage at temperatures around 80° F, 83 percent of the roots were infected. Similar magnitudes of infection were experienced in 1951 in experimental plots grown near a source of inoculum at the McCullers Experiment Station in Wake County.

These experiments and observations clearly show that the incidence of internal cork in originally healthy plants increases in all sweetpotato sections of North Carolina. The rate of spread and increase suggests that an insect vector (or vectors) is present in all sweetpotato growing areas. Rankin (5) has reported aphids, particularly Myzus persicae, to be the vector in Georgia.

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PEACH WART VIRUS IN NEW MEXICO[1]

John E. Chilton

During the late summer of 1952, in a small orchard near Farmington in San Juan County, New Mexico, the author noticed several peach trees which produced severely warted fruit. The warts were very prominent, conspicuously red-colored, and predominantly grouped ringlike near the styler end. They were very tough and leathery in texture and appeared to be quite superficial. The tissues underlying the warts were not markedly abnormal although somewhat pitted with gum pockets. The symptoms agreed in all respects with those published for the peach wart virus disease caused by Galla verrucae Blod. (3). The occurrence of the disease was found only on trees of the Candoka variety, an uncommon variety in the area. This paper marks an extension of the known geographical range of the virus.

Peach wart is of minor importance where it has been reported previously. Since the original report in Idaho (1), its occurrence has been noted in Oregon, Washington, and California (3). Blodgett (2) reported the variety Candoka, among others, to be susceptible to the virus. Although grafting techniques have been the only known method of transmitting the virus, a slow natural increase was observed by Blodgett.

Inasmuch as frost eliminated the 1953 peach crop, further investigation consisted of interviews of growers throughout the county. Only four growers were found to be acquainted with the disease, and only in the orchards of these four growers were there trees of the Candoka variety. The following story as to the origin of the disease in the county was pieced together from information given by these growers.

Between 1937 and 1940, one grower (not residing in the county at present) while on a trip through the Pacific Northwest, obtained Candoka nursery stock from a nursery believed to be near Portland, Oregon. These trees were subsequently distributed among the four orchards now containing them. Specific information is lacking, but it is said that warty peaches occurred on some of these trees in the second crop year and each succeeding year. In all orchards, the growers reported only a small number of the total trees infected, and no varieties other than Candoka have ever produced warty fruit.

The information obtained indicates that the disease was introduced into the county on the Candoka nursery stock. Confinement of the disease to Candoka trees for the past 15 years or more without its spreading to adjacent trees of other varieties known to be susceptible indicates that no vector of the virus is present in the area.

Parallel circumstances are discussed by Stout and McClain (4) concerning an outbreak of peach wart in California, where the disease was found in several counties, but only on trees topworked with Candoka scion wood from a Wenatchee, Washington nursery.

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NEW MEXICO AGRICULTURAL EXPERIMENT STATION

[1] Contribution No. 92 from the New Mexico Agricultural Experiment Station, Department of Biology, State College, New Mexico.

TOBACCO MOSAIC VIRUS IN DATURA METELOIDES DC. AND NICOTIANA GLAUCA GRAHAM IN ARIZONA

Paul D. Keener

Recognized sources of reference (1, 2, 3, 4, 5, 6, 11) indicate that reports of the occurrence in nature in the United States and elsewhere, of tobacco mosaic virus strains inducing yellow mottle symptoms in Datura meteloides DC. (Sacred Datura) and in Nicotiana glauca Graham (Tree Tobacco) are infrequent. Holmes (4, 5) lists D. stramonium L. and N. glauca among others as hosts but does not distinguish natural from artificial infections. Various species of Datura and Nicotiana have been used extensively as indicator plants and have been artificially inoculated with tobacco mosaic and other viruses with success.

McKinney (7) reported natural infections of N. glauca by tobacco mild dark-green mosaic virus, Marmor constans McKinney from, the Grand Canary and Teneriffe Islands. Some of the isolates from N. glauca seemed to consist of closely related yellow types. Marmor constans (7) is apparently identical with Tobacco virus 12 of James Johnson and Nicotiana virus 6 of Kenneth M. Smith. Recently Nariani and Singh (9) described a virus disease of N. glauca in India. These authors state that the virus responsible induces symptoms suggestive of a strain of cucumber mosaic virus.

In Arizona, specimens of D. meteloides and N. glauca infected in the wild with a tobacco mosaic virus strain inducing general yellow mottles, exhibit symptoms as follows: In D. meteloides the yellowed areas are diffuse and spreading with no sharp demarkation of the chlorotic areas other than when the symptoms appear as dots or small blotches. Frequently the yellow mottle is in the form of wavy lines (Fig. 1). Leaves are generally of normal size and shape and there are no pronounced symptoms other than the yellow mottling. In N. glauca the same virus usually causes the formation of irregular blotchy mottling. Often the pattern assumes the form of definite rings (Fig. 2). In nature the rings consist of alternating bands of green and yellow. The green rings are slightly raised above the normal level of the leaf surface.

Materials from both D. meteloides and N. glauca infected in the wild were macerated and the sap expressed through two layers of sterile fine-mesh cheese cloth. The resulting materials were diluted approximately 1:1 with sterile distilled water. Plants of N. tabacum (Samsun) were inoculated, using the customary swabbing expressed sap technique after dusting with fine carborundum (Grade FFF). Similar material was inoculated on plants of N. glutinosa. After inoculations excess carborundum was washed lightly from the leaves.

Symptoms suggestive of tobacco mosaic virus appeared in leaves of N. tabacum after seven to eight days (Fig. 3). The resulting yellow to light-green mottle was diffuse and irregular. In addition, small blister-like elevations appeared along the leaf edges and the edges of the leaves rolled inwardly (Fig. 3). On N. glutinosa local lesions appeared in four to five days.

Inclusions of the X-body type were observed in cells of leaves of D. meteloides in materials infected in nature when such materials were stained with Phloxine and Trypan Blue according to the technique of McWhorter (8). Owing to the nature of the host the identity of the X-body-like inclusions was not so easily determined as in cases described for other species of plants infected with tobacco mosaic virus. Cells from leaves of plants of N. tabacum inoculated with materials from either D. meteloides or N. glauca infected in the wild, exhibited distinct X-body types of intracellular inclusions when materials were prepared by McWhorter's technique (8, Test 2 using Phloxine and Trypan Blue).

Admittedly the interpretation of what consitutes "natural" infection in these instances is subject to criticism. Nevertheless, the occurrence of a strain of tobacco mosaic virus (Marmor tabaci) inducing yellow mottle symptoms in non-cultivated specimens of D. meteloides and N. glauca is of interest. The systemic invasion of artificially inoculated specimens of N. tabacum as well as the production of necrotic local lesions in inoculated leaves of N. glutinosa indicate that tobacco mosaic virus is distributed in nature in some weeds in Arizona. It has been observed that the majority of wild plants showing yellow mottle symptoms are located at various view points, camp sites and other public gathering places throughout the State. It is rather difficult to account for the occurrence of similar yellow mottle symptoms in plants interspersed between such locations. Many of the infected plants are located in regions not usually traversed. Perhaps some unrecognized vector exists. A recent report confirms the fact that at least some mealybug species are capable of transmitting tobacco mosaic virus (10).

FIGURE 1.

FIGURE 3.

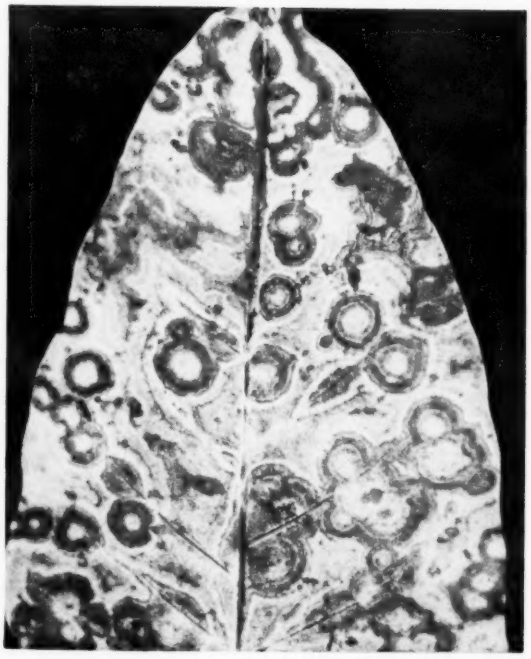

FIGURE 2.

Tobacco mosaic virus strain in Arizona.
FIGURE 1 -- Natural infection in Datura meteloides.
FIGURE 2 -- Natural infection in Nicotiana glauca.
FIGURE 3 -- Symptoms in Nicotiana tabacum inoculated with virus from naturally infected D. meteloides and N. glauca.

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UNVIERSITY OF ARIZONA, TUCSON

CONTROL OF TOBACCO BLUE MOLD BY ANTIBIOTICS

John J. Grosso

A series of greenhouse experiments was conducted to test the fungicidal value of various antibiotics in the control of the blue mold, Peronospora tabacina, disease of tobacco.

Spray treatments were begun when the leaves were approximately the size of a silver dollar and continued at three to four-day intervals for a total of four applications. The day following the second application, the plants were placed in an incubation chamber and inoculated on two successive days with a water suspension of spores. Five days following the last spray treatment the amount of blue mold damage was recorded.

In the first series, Thiolutin at concentrations of 0.8, 2.4 and 7.2 p.p.m. was used. Results showed that Thiolutin at all three concentrations gave no control of blue mold.

In the second series of tests, 0.01% aqueous spray solutions of the following antibiotics were used: Bacitracin, Catanulin, Magnamycin, Polymyxin, Sodium Penicillin, Sodium Rimocidin, Sodium Salt PA95, Streptomycin sulfate, Terramycin hydrochloride, and Thiolutin. The amount of leaf killing ranged from 1.8 percent for Streptomycin sulfate to 40.6 percent for Bacitracin. The Dithane treated check had 1.7 percent leaf injury while the figure for the untreated check was 30 percent. See Table 1.

Table 1. Tobacco blue mold control with various antibiotics.

Treatment	Disease Index*	Treatment	Disease Index
Check	30.0	Sodium Salt PA95	14.5
Dithane	1.7	Magnamycin	14.9
Streptomycin SO_4	1.8	Terramycin HCL	16.6
Polymyxin	7.2	Sodium Penicillin	26.7
Thiolutin	7.6	Catanulin	33.6
Sodium Rimocidin	13.3	Bacitracin	40.6

* 100 = All leaves destroyed; 0 = No disease.

As a result of this experiment, another was conducted with Streptomycin sulfate, using 0.02%, 0.01%, and 0.005% aqueous solutions. In all three replications the 0.02% and 0.01% solutions were far superior to the Dithane-treated check, averaging 1.1 percent and 5.2 percent leaf injury, respectively. The 0.005% solution was inferior, averaging 19.4 percent damage. The Dithane-treated check averaged 12.7 percent injury while the untreated check averaged 50 percent. See Table 2.

Table 2. Tobacco blue mold control with streptomycin sulfate.

Treatment	Disease Index*			
	Block 1	Block 2	Block 3	Mean
Check	59.0	55.0	36.0	50.0
Dithane 3 lb. per 100 gal.	13.5	14.4	10.3	12.7
Streptomycin SO_4 0.005%	16.0	22.2	19.9	19.4
Streptomycin SO_4 0.01%	5.0	6.6	4.0	5.2
Streptomycin SO_4 0.02%	0.5	1.9	0.9	1.1

* 100 = All leaves destroyed; 0 = No disease.

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MARYLAND

MOLDY ROT OF THE HEVEA RUBBERTREE IN COSTA RICA[1]

J. B. Carpenter[2]

Moldy rot is one of the two major fungus diseases[3] of the tapping panel of the hevea rubbertree, Hevea brasiliensis (Willd. ex A. Juss.) Muell. Arg. and other species. The fungus is usually designated as Ceratostomella fimbriata (Ell. & Hals.) Elliott and is widely distributed in tropical rubber growing areas (6, 8). The most recent general descriptions of the disease are those of Sharples (9) and Martin (8).

Martin (8) published in 1949 the first record of moldy rot from Costa Rica, where he had seen it a few years earlier at the Speedway Estate of the Goodyear Rubber Plantations Company of Costa Rica, at Cairo. The disease remained insignificant and of sporadic occurrence until May 1952, when a small outbreak occurred at the same place. It involved some 80 acres in two widely separated blocks about four miles apart. The disease was tentatively identified by H. Echeverri, who requested assistance with this problem.

Identification

The fungus was identified as a species of Ceratostomella by examination of diseased material from tapping panels. An abundance of, of endoconidia, both hyaline and dark, and perithecia were being produced in typical lesions. The lesions are dark, depressed areas often parallel to the tapping cut. At their lower margin, they have a thick grayish weft of mycelium, 2 to 3 mm. thick, that becomes progressively thinner above and shades into a dark brown color. This latter area is often studded with long-necked perithecia. In profile, these have a bristly appearance and are frequently capped with bright tan masses of extruded ascospores.

The moldy rot fungus has usually been ascribed to Ceratostomella fimbriata but, on the basis of the specimens furnished to him, W. W. Diehl has preferred to designate the fungus as Ceratostomella sp. pending further investigations. Numerous collections made from moldy rot infections over a period of eight months yielded a similar fungus.

Comparative Inoculation Studies

Comparative inoculations were made on seven trees with the Ceratostomella sp. and with Phytophthora palmivora for the purpose of training supervisors in distinguishing between the two diseases. The behavior of these fungi in regard to canker extension and healing was also observed. The trees were untapped, about 5 in. in diameter, and in a block that was apparently free of both diseases at that time.

Three 3-inch-square areas, arranged in a staggered vertical order, were scraped in the soft bark of each tree. On each, the control square was uppermost and was sprinkled with water only; Ceratostomella was inoculated into the middle square, using a suspension of naturally produced spores and mycelium from infected panels; Phytophthora was inoculated into the lower square, using a suspension of sporangia from naturally infected rubber seed pods. Each square was covered with a 7-inch-square pad of cotton-filled cloth. These were put on while wet and remoistened the following day.

The inoculations were examined seven days later, with the following results: (a) The con-

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[1] Cooperative investigation of the United States Department of Agriculture and the Ministry of Agriculture and Industry of Costa Rica, conducted on the Speedway Estate of the Goodyear Rubber Plantations Company of Costa Rica, at Cairo, and at the U. S. D. A. Cooperative Rubber Plant Field Station, at Turrialba.

[2] Senior Pathologist, Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

Grateful acknowledgment is made to: Señor Ingeniero don Hernán Echeverri Yglesias, Manager, the Goodyear Rubber Plantations Company of Costa Rica, for courtesies and facilities enjoyed during the work at the plantation and for permission to report the Company's disease survey and control information; W. W. Wirth, Entomology Research Branch, for identifying insect specimens; John A. Stevenson and W. W. Diehl, Horticultural Crops Research Branch, for identifying fungus specimens; M. H. Langford and E. P. Imle, Field Crops Research Branch, for consultation and criticism of the manuscript.

[3] The other disease is black stripe of the tapping panel, caused by Phytophthora palmivora Butler.

trols were disease-free and already callusing over. (b) Ceratostomella had rotted the bark on the scraped areas and stained the underlying wood in some places to a depth of a few millimeters. Both of the conidial stages and perithecia were abundant. Dark lines were found in the wood that extended 8 inches below the square. (c) Phytophthora made typical lesions, with pads of rubber formed between the wood and bark and coagulated rubber strands in the bark. After this examination, all of the infected squares were washed twice with cresol disinfectant and then, when dry, covered with coal-tar paint.

These trees were reëxamined about six months later to see how healing had progressed. The control squares were healed completely. The Ceratostomella cankers were healing well and, except in two minor instances, there had been almost no spread outside of the original square. Out of the 9 sq. in. of the original area, an average of only 6 sq. in. remained unhealed. All of the Phytophthora cankers had elongated both above and below the square and had an average of 21 sq. in., or more than twice the original area. These were mostly corked-off and forming marginal callus.

Inoculations were made at the U.S.D.A. Cooperative Rubber Plant Field Station, at Turrialba, with inoculum from moldy rot lesions collected at the Goodyear plantation. The fungus developed slowly and the infections were maintained only with difficulty. It was necessary to keep them loosely covered with a damp, cotton-filled pad, and the tapping cut was renewed almost daily. This difficulty may have been due to temperature differences, as the Station is about 500 meters higher than the Goodyear plantation and is cooler. Moldy rot has not been found occurring naturally at Turrialba.

Sources of Inoculum

With the able assistance of A. Rivera, an employee of the Company, a search was made within the Goodyear plantation for possible sources of inoculum from which the infections might have originated. Beele (3) and Altson and Newsam (2) have described the saprophytic development of species of Ceratostomella in plantations in Malaya. They concluded that saprophytic strains of C. fimbriata and also other species of Ceratostomella exist on dead rubber wood and other substrata in the plantation. Their importance as sources of inoculum for moldy rot infections has not been fully evaluated.

Presumed species of Ceratostomella were found in the Goodyear plantation developing saprophytically on hevea rubber wood as follows: (a) standing dead stumps, (b) freshly exposed wood of recently broken, wind-damaged trees, and (c) freshly cut surfaces of stumps and logs during thinning operations. In this latter instance, there was a massive development of the fungus over large areas. The fungus was visible within three or four days after the trees were felled, forming bristly, dark-colored colonies with abundant perithecia and scant aerial mycelium.

In February 1954, species of Ceratostomella were found again on the freshly splintered wood of recently fallen trees at the Goodyear plantation. This material was studied at Turrialba. Three distinct types of the fungus were found on the wood and in pure culture isolations: Type A, conforming in general to C. fimbriata; Type B, distinguished by relatively long, pluriannulate necks on the perithecia, varying from 1 to 3 annulae in addition to the apical setae; and Type C, with relatively large, dark, pear-shaped perithecia that are superifical on wood or agar. The base is often reclinate, although the neck is vertical. The entire dilated base of the perithecium bears prominent, dark, blunt hyphal processes. In culture this type has a strong fruity odor, similar to that of banana oil.

Inoculations were made on freshly opened tapping cuts, using a suspension of spores and mycelium scraped from the naturally infected wood. These were kept covered with moist cotton-filled pads and tapped almost daily. After 12 days, six out of ten tapping cuts had perithecia in small groups of a few to over 100. The two most abundant groups, each on separate trees, were reinoculated into three trees each. They were also used as sources of pure culture. After seven days, under the same conditions as those described above, all three trees inoculated from one group yielded perithecia but the trees inoculated from the other group had none. These two groups were of Type C. The bark and wood underneath the perithecia were discolored but no typical moldy rot developed.

These results, though inconclusive, point to the need for a thorough study of these and other saprophytic species or strains of Ceratostomella in relation to moldy rot as potential sources of inoculum. Under the conditions described herein, where the fungus apparently is not harbored constantly on the tapping panels, there must be a reservoir of inoculum in or near the plantation.

Insects Associated with Moldy Rot

A small drosophilid fly, identified by W. W. Wirth as Chymomyza bicoloripes (Malloch) has been found constantly associated with active moldy rot lesions and saprophytic colonies of Ceratostomella, beginning with the first observations in May 1952. The flies were found so constantly visiting the moldy rot infections that lesions were often detected several trees away from the observer by the activity of the flies. The flies were not seen visiting those panels bearing sporangia and mycelium of Phytophthora palmivora nor those with superficial saprophytes, especially an ubiquitous Fusarium. Chymomyza bicoloripes was also collected at Turrialba on moldy rot lesions resulting from artificial inoculation. The flies apparently sought out the infections, as they were found visiting lesions beneath the cotton-filled pads used to cover the inoculations.

Great numbers of this same fly were found visiting the active colonies of Ceratostomella on wind-damaged trees and freshly cut stumps and logs mentioned above. In the latter case, the flies were found walking over day-old surfaces, although the fungus was not visible until three or four days after felling. Observation of these insects suggests that they have a rôle in dissemination of the fungi involved. However, preliminary attempts to study caged insects were unsuccessful, so this point has not been determined.

The reason for the association of this fly with the species of Ceratostomella mentioned here is not known but, in addition to abundant food, in the form of mycelium and spores, some odor attractive to these flies may be produced. Davidson (4) states that "...The production of a distinct odor seems to be a character common to all of the species (of the Endoconidiophora group)..." and that E. coerulescens Münch "...produces a very characteristic and penetrating odor both in culture and in the lumber yard. This odor differs noticeably from that produced by any of the other Endoconidiophora species with which the writer has worked." Lagerberg, Lundberg, and Melin (7) state that the Swedish E. coerulescens has an odor that is due to the production of amyl acetate. Hubert (5) compared the odor of the same fungus to that of butyl alcohol. The production of a distinct odor by the Type C isolates has been referred to elsewhere in this paper.

Many small crawling insects, especially ants and some small beetles, were found visiting the colonies of Ceratostomella on broken trees, freshly cut surfaces of rubber wood, and covered, artificial inoculations. However, there was no constant association of readily distinguishable types similar to that observed with Chymomyza bicoloripes.

Control Measures

When the presence of moldy rot was verified at the Goodyear plantation, the Company made a survey in the affected blocks. Assistance was given to the Company in training supervisors to recognize the disease. All infected trees were marked and dated to aid in later inspections. Tapping panel infection in one of the two 40-acre blocks was 6 percent (280 trees) and in the other was 11 percent (260 trees).

The Company immediately undertook two schedules of control measures. In one block, the infected trees were treated with coal-tar paint (8, page 15) and taken out of tapping for at least one month; the trees in tap were treated with coal-tar paint once a week. In the other block, all of the trees were kept in tap and received an application of coal-tar paint the day following each tapping. This latter method was preferred.

In the six month period from June through November, no new infections were found when coal-tar paint was applied regularly. During two brief lapses in treatment, a few new infections appeared but these apparently were not from latent infections on the same panel. This was determined by removing carefully from several trees a band 3 to 5 inches wide of coal-tar paint and the renewed outer corky bark from the area between the June infections and the current tapping cut, in November. The renewing bark was mostly sound over this whole area, as the June infections had been arrested. A few small, isolated patches of discolored bark were found on some of the exposed areas, but these could not be attributed to Ceratostomella with any certainty.

From the observations and data available, it appears that moldy rot is not nearly as formidable a disease under the conditions where it has been found in Costa Rica as in Malaya and Mexico. Martin (8) found no satisfactory treatment for the disease in Mexico, including the coal-tar paint. Altson (1) and Altson and Newsam (2) have reported favorably on Fylomac No. 90, a preparation of tetradecyl pyridinium bromide, for the cure and prevention of moldy rot under the severe conditions encountered in Malaya.

Summary

An outbreak of moldy rot, caused by Ceratostomella sp., on the tapping panel of hevea rubbertrees in Costa Rica is described. Comparative inoculations with that fungus and Phytophthora palmivora yielded typical infections for each pathogen. The subsequent behavior of the cankers produced by them was studied. Species of Ceratostomella falling into three distinct types were found commonly on freshly cut or broken rubber wood and less frequently on older dead wood. Their importance as potential sources of inoculum for moldy rot infections was not established. However, where the disease appears only sporadically, as in the present case, some reservoir of inoculum must exist in or near the plantation. A drosophilid fly, Chymomyza bicoloripes, was associated constantly with moldy rot lesions on tapping panels and with saprophytic colonies of Ceratostomella. Observation suggests that this fly may have a rôle in dissemination of the species of Ceratostomella encountered in rubber plantations. Other small insects were also found on and around those colonies but not in any constant assocaition. Control of moldy rot on the tapping panel is discussed.

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UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATIVE RUBBER PLANT FIELD STATION, TURRIALBA, COSTA RICA

BACTERIAL FIRE BLIGHT OF RASPBERRY ASSOCIATED WITH RASPBERRY CANE MAGGOT

Donald Folsom[1]

In 1947 at Carmel in central Maine a bacterial blight was observed on Latham red raspberry plants. The symptoms resemble those of the fire blight of apple and pear.

(1). The causative organism was found to be bacteriologically identical with Erwinia amylovora but nonpathogenic on apple, and was desiganted as Erwinia amylovora f. sp. rubi, f. sp. nov. causing bacterial fire blight of raspberry (3).

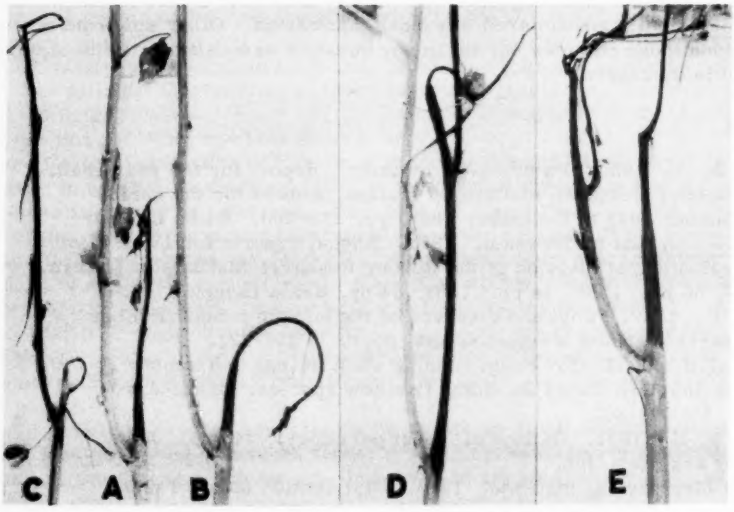

FIGURE 1. A and B, canes with maggot injury and purpling limited to terminal shoot. C, cane with maggot injury in terminal shoot and blight extending from terminal shoot through side shoot. D, cane with maggot injury in terminal shoot and blight extending through upper side shoot and down main stem to junction with second side shoot. E, cane with maggot injury in terminal shoot and with blight in terminal shoot and having spread aerially to side shoot.

The disease recurred in the Carmel plantation in 1948, 1949, and 1950. In 1951 weekly inspections were made and all young shoots which showed girdling by the raspberry cane maggot (Phorbia rubivora or Hylemyia rubivora or Pegomya rubivora) were removed immediately to the laboratory and placed in humid air. Some maggot-injured shoots showed no purpling, some showed purpling with milky-colored bacterial drops indicating fire blight, and some showed purpling with no bacterial drops. Only one cane developed fire blight in its upper part. Apparently the early removal of the maggot-injured young sprouts practically eliminated the disease. In another plantation at Pittsfield, a few miles distant, where no roguing was done, there was no trouble in finding the disease at different distances from the ground, indicating spread from small maggoty shoots to the normal fast-growing canes.

An attempt to discover other affected plantations was made in 1951 through radio and news paper publicity, but only one, at Lagrange in central Maine, was learned about. Here about 30 percent of the canes were affected at various heights from the ground.

In 1952 no epidemic developed in the Carmel plantation, although no roguing was done; apparently the 1951 roguing had sufficed to eliminate the disease. This plantation was dug up by

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FIGURE 2. A, upper part of shoot with veins of one leaflet turned dark purple by blight and with upper leaves dying from girdling effect of blight in stem. B, cane with blight in upper part. C, same cane as in B, photographed later with fungus appearing in stem as secondary invader.

the owner in the fall. There was some blight in the Lagrange plantation and weekly roguing here was planned for 1953. Such roguing disclosed that new infection was not associated with the location of canes that had become blighted in 1952 but was associated with maggot injury occuring in 1953. Figure 1 shows instances of blight extending from the maggot-injured terminal shoot into other parts of the cane or spreading to a nearby side shoot. Further spread to the upper still immature parts of growing canes occurred only in rainy weather, as usual. (See Fig. 2 for symptoms.)

Overwintering of several bacterial diseases in maggots and other insects is discussed at length by Leach (2).

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MAINE AGRICULTURAL EXPERIMENT STATION, ORONO, MAINE

MEADOW NEMATODES ON RASPBERRIES AND BLACKBERRIES

Austin C. Goheen[1]

Several authors (1, 2, 3, 4) have reported meadow nematodes, Pratylenchus spp., on various cultivated brambles. Most of these reports are from western North America. Unpublished records of the Nematology Section of the Horticultural Crops Research Branch show that meadow nematodes have been identified by that Section from cultivated brambles on two occasions in the past 23 years. One specimen was from Washington State and the other from New York. No quantitative information on the abundance of the nematodes within the roots or soil has been recorded although Berkeley (2) indicated that the nematodes were present in great numbers on and in the roots of raspberries from a farm in British Columbia.

In eastern North America, particularly in the section from Maryland southward, many cultivated brambles, particularly raspberries, do not grow well. The gradual decline characteristic of plantings in this section indicates that a build-up of nematodes might be a cause of this poor growth. For this reason surveys of bramble species and varieties at Raleigh, North Carolina, and at Beltsville, Maryland, were made during February 1954. This is a report of the nematodes found in the roots of various Rubus species and varieties in the two areas.

Small root samples of 23 Rubus species and varieties growing on the Farm of the North Carolina Agricultural Experiment Station were sent to the author by C. F. Williams. At the same time, root samples of Rubus species and varieties were gathered from the Plant Industry Station and from the University of Maryland Horticultural Farm. Sufficient roots were collected in most samples so that 1 to 4 grams of feeder roots could be weighed and analyzed for nematodes. Nematodes were isolated and counted in a manner similar to that described by Taylor and Loegering (5) in their article on meadow nematodes in abacá. The weighed specimens of feeder roots were comminuted for 30 seconds in approximately 80 ml. of water in a Waring Blendor. The comminuted mixture was then washed through 50-, 100-, and 200-mesh sieves with approximately equal amounts of water for each sample. The material caught on the 200-mesh sieve was concentrated along one edge and washed back into a beaker with exactly 100 ml. of water. One-ml. aliquots of the material were pipetted and placed into Scott Counting Slides and examined for meadow nematodes. If nematodes were abundant in the samples, 3 ml. only were examined. However, if nematodes were not found in 3 ml., several additional examinations were made before the sample was recorded as free of nematodes. The number of nematodes per gram of roots was then calculated on the basis of the weight of the original sample and the number of nematodes found in the aliquots.

Meadow nematodes were found in 19 of the 23 Rubus specimens from North Carolina and in all 6 of the Rubus specimens from Maryland (Table 1). The population of these nematodes on several of the plants was very high, especially for mid-winter.

In addition to the root samples, small soil samples from the vicinity of the roots of some specimens were examined for ectoparasitic nematodes. No effort was made to make a quantitative determination of these soil inhabitants. Specimens of Criconema sp. were found associated with roots of Eldorado blackberry from the Maryland Horticultural Farm near Beltsville but no other ectoparasites were found on any sample examined.

A few wild brambles from the vicinity of Beltsville were also examined for nematodes. No meadow or ectoparasitic nematodes were found in or on the roots of Rubus occidentalis or of wild blackberries from the subgenus Eubatus of Rubus. Although the number of examinations was limited, wild brambles in the vicinity of Beltsville are apparently free of plant parasitic nematodes.

These surveys indicate that meadow nematodes are widespread on cultivated brambles in Maryland and North Carolina. In some cases these nematodes are found in very large numbers. Nematodes may be an important factor in the decline of some cultivated brambles in eastern North America. The effect of these nematodes on bramble-fruit production in all small-fruit-producing sections requires further investigation.

Since the data in most cases are based on single specimens no conclusions can be made on the relative abundance of meadow nematodes on the different brambles. The possibility that certain varieties or species are actually more resistant to the nematodes than others should be investigated further in controlled experiments.

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[1] Pathologist, Horticultural Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

Table 1. Meadow nematodes (Pratylenchus sp.) recovered from the roots of species and varieties of Rubus.

Species, variety, or selection number	Location	Nematodes/gram of feeder roots
Cameron (blackberry)	North Carolina	938
Boysen (blackberry)	North Carolina	896
Manteo (black raspberry)	North Carolina	533
R. biflorus 37-4-14 (raspberry sp.)	North Carolina	444
Merton Thornless (blackberry)	North Carolina	408
Brainerd (blackberry)	North Carolina	278
R. parvifolius 1164-4 (raspberry sp.)	North Carolina	228
NC-237 (red raspberry)	North Carolina	190
R. coreanus 33-11-23 (black raspberry)	North Carolina	128
Dixie (red raspberry)	North Carolina	107
Oregon 731 (red raspberry)	North Carolina	67
Manderin (red raspberry)	North Carolina	45
R. albescens (black raspberry)	North Carolina	35
NC-219 (red raspberry)	North Carolina	25
Earliness (blackberry)	North Carolina	14
NC-207 (red raspberry)	North Carolina	13
R. kuntzeanus (raspberry sp.)	North Carolina	9
Carolina (trailing blackberry)	North Carolina	6
NC-107 (blackberry)	North Carolina	5
37-6-4 (red raspberry)	North Carolina	0
Lucretia (trailing blackberry)	North Carolina	0
NC-210 (red raspberry)	North Carolina	0
R. wrightii (raspberry)	North Carolina	0
SM-3-5 (red raspberry)	Maryland (University Farm)	266
Merton Thornless (blackberry)	Maryland (Plant Industry Station)	133
Eldorado (blackberry)	Maryland (University Farm)	107
Manteo (black raspberry)	Maryland (Plant Industry Station)	18
Carolina (trailing blackberry)	Maryland (Plant Industry Station)	15
Brainerd (trailing blackberry)	Maryland (Plant Industry Station)	13

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WIDESPREAD OCCURRENCE OF ROOT PARASITIC NEMATODES IN GOLF COURSE GREENS IN RHODE ISLAND[1]

J. Troll and A. C. Tarjan

A number of the samples of fine turf submitted for disease diagnosis during the past two years were found to contain large populations of plant parasitic nematodes associated with roots and soil. It seemed desirable to determine the geographic distribution of these parasites on a qualitative and approximate quantitative basis; consequently, a survey of 41 putting greens from 17 different golf courses situated throughout the State was undertaken.

Root and soil samples were selected from sections of greens which contained definite symptoms of chlorosis and/or dieback of grass blades. Turf exhibiting chlorotic patches of varying size and intensity occasionally would contain bare areas where individual plants had died out completely. In many cases, annual bluegrass (Poa annua) confused the symptom picture because of its natural yellow cast in the fall of the year, at which time samples were obtained.

Close examination of individual grass plants in the diseased area showed dieback, or dead blades interspersed with healthy green blades of grass. This condition, to the best of our knowledge, is not caused by any of the fungi attacking grasses in the New England area.

Root and soil samples were obtained from each of two areas within each green with the aid of a 4-inch cup cutter, and then combined. Isolation of nematodes from each composite sample was accomplished using the technique described by Christie and Perry (2).

Frequency of occurrence of individual genera identified are listed in Table 1. Most identifications were made to genus with certain specimens being further identified to species. The most widely distributed plant-parasitic nematodes found in this survey were the stunt nematodes, Tylenchorhynchus spp. The predominant member of this genus in Rhode Island turf soil was Tylenchorhynchus claytoni Steiner. In one instance where grass had grown poorly for several years, an extremely large population of this species was found in the soil. Tylenchorhynchus dubius (Bütchli) Filipjev also was found in several cases in combination with T. claytoni or with other nematodes. In view of the numerous reports on the pathogenicity of this genus (1, 3, 4), it is very likely that Tylenchorhynchus plays a major role in devitalizing bentgrass (Agrostis) turf in Rhode Island.

The spiral nematodes, Rotylenchus erythrinae (Zimmerman) Goodey, were not as widespread as the stunt nematodes, but nevertheless were found in more than half of the greens investigated. It is of interest that in those samples where spiral nematodes occurred, they were usually present in larger numbers than were other coexisting species.

A nominal number of samples contained Heterodera sp., Pratylenchus pratensis (de Man) Filipjev, and Tylenchus sp. The Heterodera sp. observed appeared close to H. major (Schmidt) Franklin in regard to cyst shape, cyst wall markings, and larval characteristics. However, since these nematodes were not cultivated on various hosts, no attempt was made toward positive specific identification. The meadow nematodes (P. pratensis), although occurring in 25 percent of the greens examined, were relatively few in number. Since these animals are endoparasitic cortical feeders, it is possible that many of them existed within the grass roots and escaped our detection. The tylenchs (Tylenchus spp.), usually regarded as plant parasites, are frequently encountered in soil but seldom in large numbers. It can be generalized, from the results of this survey, that although the tylenchs contribute to the overall damage done to grass roots, they are less destructive than some of the genera already discussed.

The discovery of Psilenchus hilarulus de Man in eight greens indicates that this species may be more of a problem to successful culture than previously thought. Results of examination of numerous soil and root samples from many different kinds of plants from Rhode Island over the past 2 1/2 years, as well as the results in Table 1, suggest that lance nematodes (Hoplolaimus coronatus Cobb), ring nematodes (Criconemoides sp.), pin nematodes (Paratylenchus sp.), and Ditylenchus sp. may contribute to grass root damage but rarely are entirely responsible for it.

Among the number of suspected plant parasites listed in Table 1, Dorylaims (Dorylaimus spp.) are a large group in which plant parasites are known to occur. Similarly suspected of being plant-parasitic are the needle nematodes, Xiphinema americanum Cobb, and their close relatives, Longidorus sylphus Thorne. Numerous experiments in our greenhouses, attempting to demonstrate the pathogenicity of X. americanum and Pungentus pungens Thorne & Swanger on a number of hosts including bentgrass, have ended in failure. This does not necessarily

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[1] Contribution No. 840 of the Rhode Island Agricultural Experiment Station, Kingston.

Table 1. Nematodes found associated with roots and soil in 41 putting green samples.

Type	Total occurrence	Relative intensity	
		Many	Few
	Number of greens		
Known Plant Parasites			
Heterodera sp.	13	3	10
Pratylenchus pratensis	10	1	9
Tylenchus spp.	14	0	14
Tylenchorhynchus spp.	30	10	20
Rotylenchus erythrinae	21	7	14
Ditylenchus spp.	6	1	5
Paratylenchus sp.	3	0	3
Psilenchus hilarulus	8	1	7
Hoplolaimus coronatus	5	1	4
Criconemoides sp.	1	0	1
Suspected Plant Parasites			
Xiphinema americanum	8	2	6
Pungentus spp.	18	4	14
Dorylaimus spp.	29	2	27
Tylencholaimus spp.	6	3	3
Longidorus sylphus	5	0	5
Diphtherophora sp.	1	0	1
Dorylaimellus spp.	7	0	7
Enchodelus sp.	1	0	1
Non-Plant Parasites			
Acrobeles sp.	4	0	4
Eucephalobus spp.	10	0	10*
Diploscapter sp.	1	0	1
Acrobeloides sp.	3	0	3
Nygolaimus spp.	6	0	6
Aporcelaimus sp.	7	0	7
Cephalobus sp.	3	1	2
Mononchus sp.	2	0	2
Alaimus sp.	1	0	1
Panagrolaimus sp.	1	0	1
Plectus sp.	10	0	10
Monhystera sp.	3	0	3
Rhadbitis spp.	3	0	3

*Found in leaves of 1 sample.

indicate that these species are not parasitic, but only that our attempts may not have duplicated true field conditions, consequently the nematodes were unable to feed and multiply. The remaining genera under "suspected plant parasities" in Table 1 are forms which bear the necessary head and mouth structures to be plant-parasitic and have been found associated with numerous cases of plant decline. Definite proof of the pathogenicity of these forms, however, is lacking.

The genera listed under "non-plant parasites" are not considered to be plant parasitic but may be saprophagous, predatory, etc. Possible exceptions to this may be Eucephalobus spp. and Panagrolaimus sp. which were found to be associated with the diseased grass shoots in one sample. A similar case was described by Tarjan and Ferguson (5) in their investigations of a disease condition of bentgrass known as "yellow tuft."

Results of this survey show that a variety of plant-parasitic nematodes do occur in fine turf

greens where unexplained diseases exist. It had been assumed that plant nematodes were of only slight significance in areas of the country subject to "colder climates." It is hoped that surveys such as the one reported in this paper eventually will result in the abandonment of this fallacious view.

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RHODE ISLAND AGRICULTURAL EXPERIMENT STATION, KINGSTON

NEW GRASS HOST RECORDS AND LIFE HISTORY OBSERVATIONS OF DWARF BUNT IN EASTERN OREGON[1]

John R. Hardison[2]

In 1952 Hardison and Corden (3) reported a serious outbreak of dwarf bunt, Tilletia caries (DC.) Tul. (T. brevifaciens G. W. Fischer), in Tualatin oatgrass, Arrhenatherum elatius (L.) Presl. in seed fields of eastern Oregon. Infected plants of Agropyron elongatum (Host) Beauv. (Figure 1), and A. intermedium (Host) Beauv. were also collected. Fischer (2) had earlier reported infection in A. intermedium and A. subsecundum (Link) Hitchc. in Idaho.

Dwarf bunt spore balls were found in seed samples of Agropyron trichophorum (Link) Richt., Festuca arundinacea Schreb., F. rubra L., F. ovina var. duriuscula (L.) Koch, and Poa pratensis L.[3], indicating that several other grasses apparently were infected in 1952 in Union County, Oregon.

FIGURE 1. Dwarf bunt infection in Agropyron elongatum on right. Healthy on left. About 3/4 x.

FIGURE 2. Dwarf bunt infection in red fescue on right. Healthy on left. About 3/4 x.

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[1] Approved for publication by the Director of the Oregon Agricultural Experiment Station and the Chief of the Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

[2] Pathologist, Field Crops Research Branch, A. R. S., U. S. D. A. and Department of Botany and Plant Pathology, Oregon Agricultural Experiment Station.

[3] Assistance of personnel and use of records of the Oregon Cooperative Federal-State Seed Laboratory at Corvallis, Oregon is gratefully acknowledged.

The spores from the different smut balls did not germinate, but had reticulations of the size and prominence characteristic of the wheat dwarf bunt fungus, T. caries. The thickness of the hyaline sheath varied in different collections.

The spore balls were uniform in individual grass seed samples and were of the relative sizes and shapes that would be expected for each of the respective grass species. Most of the grasses in question were grown in cultivated, hand-rogued rows, thus insuring a high degree of purity and largely excluding the possiblity that spore balls might have come from weed grasses. That dwarf bunt actually infected these grasses is further indicated by the prevalence and wide distribution of the disease in many fields.

Because of this evidence, certification regulations in Oregon were changed in 1952 so that the standards for the grasses listed above as susceptible to dwarf bunt now specify a maximum tolerance of 0.5 percent smut in all seed classes in field inspection. A zero tolerance was established on smut balls for seed inspection in foundation and registered seed, and only a trace in certified seed.

An effort was made to obtain specimens of diseased heads of all of these grasses in 1953. However, soil moisture was deficient in the fall and winter of 1952, and dwarf bunt was rare in the 1953 crop of grasses and wheat in eastern Oregon. A few infected plants of Festuca rubra were found after an intensive search (Figure 2). These red fescue specimens provide partial confirmation of the tentative host range suggested by the seed records.

In 1953 no bunt-infected plants were found in many fields of wheat-grasses, Alta fescue, red fescue, hard fescue, or Merion bluegrass that were badly infested in 1952. A thorough but unsuccessful search was made among standing, mature plants of Agropyron intermedium in small areas that were not harvested in 1952 because of heavy smut infestation. The absence of disease in the same plants the following year indicates that a perennial mycelium was not present in crown tissues. Lack of a perennial mycelium was not unexpected since dwarf bunt infection does not occur in spring planted wheat (1), and most fields of these grasses are planted in the spring in the problem area.

In 1953 dwarf bunt infection occurred in one four-year old field of Poa pratensis in eastern Oregon. Unfortunately, this particular field was not examined during the growing season, and the only evidence of infection was the presence of spore balls in the harvested seed. The infection was unusual for 1953 and evidently was due to more favorable soil moisture resulting from the location of the field on low, heavy soil.

In years favorable for infection, the heaviest infestations in grass fields are usually in swales and low areas where a soil moisture content favorable for infection is reached earlier and remains for longer periods than in other parts of the fields. The moisture content of the upper few inches of soil appears to be a critical factor in infection. Holton et al. (4) recorded that tamping the soil increased the percentage of infection, but they did not explain the reason as a moisture relationship. A moisture relationship was one of the factors suggested by Tyler and Jensen (6) as partial explanation for increase of infection under protective cover in New York. Because of the apparent moisture relationship, the effects of summer irrigation on dwarf bunt infection in grasses may be significant in semi-arid areas of eastern Oregon. Bluegrass is the principal grass receiving summer irrigation and it has been more frequently infected than other grass species in Union County.

Spring planting to escape infection apparently will not control dwarf smut in perennial grasses. Infection evidently occurs during fall and/or winter in the stem primordia that are still subterranean or nearly so. Promising results with a combined seed and soil treatment were described by Holton and Jackson (5). Heavy dosages of fungicides were blown over the seed in the drill row. Probably this method will be inadequate for control in the perennial grasses, because the stem primordia, as a result of lateral growth, will be located at an increasingly greater distance each year from the original seed drill row. Because the grass stem primordia appear susceptible to infection and dwarf bunt spores survive in soil for several years (4), a chemical applied to the soil would have to provide protection for a considerable period. Thorough mixing of a fungicide in the upper soil layer before planting may be necessary for the protection of perennial grasses. Trials with fungicides for dwarf bunt control in grasses are in progress in Oregon.

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RESULTS OF VEGETABLE SEED TREATMENTS IN LOUISIANA

W. J. Martin and J. G. Atkins

Vegetable seed treatment tests were made during the winter of 1952-53 to study the effectiveness of various newer chemicals recommended for that purpose by the manufacturers. The vegetable seed (untreated) were kindly furnished by Northrup, King and Company. The seed were treated by shaking in an excess of the chemical and screening off the excess. The seed were counted for each of four replicates as given below:

Vegetable	Variety	No. Seed per Replicate
Beet	Detroit Dark Red	200
Carrot	Danver Half Long	200
Eggplant	Black Beauty	150
Pea	Thos. Laxton	100
Pea	Alaska	100
Mustard	Southern Curled Giant	200
Pepper	California Wonder	200
Radish	White Icicle	150
Spinach	Nobel	200
Tomato	Marglobe	200

The seed were planted in screened Sharkey Clay Loam soil in 12-inch clay pots. The soil was watered liberally after planting and kept moist until emergence. Counts were made by pinching off the seedling after complete emergence.

The data are summarized in Table 1. A review of this data shows the following:

Table 1. Mean* number of plants that emerged of different vegetable crops used in seed treatment test in the winter of 1952-53 at Baton Rouge, Louisiana.

Seed treatment fungicide	Beet	Carrot	Eggplant	Pea		Mustard	Pepper	Radish	Spinach	Tomato
				Thos. Laxton	Alaska					
Untreated check	9.3	75.5	69.8	82.0	84.8	60.0	98.3	145.3	19.5	120.0
Arasan	161.3	138.5	82.8	96.8	94.5	124.5	136.0	138.8	82.3	138.0
Dow 9 B	171.3	94.3	54.5	--	--	116.5	33.8	19.0	82.5	97.0
Orthocide 75	176.3	154.0	87.0	95.3	92.8	127.8	136.0	147.5	45.5	139.5
Phygon	167.0	141.8	76.3	-	--	121.5	138.0	138.3	71.5	142.8
Spergon	129.5	114.5	5.0	93.0	--	113.3	119.3	137.5	50.5	86.0
Semesan	164.0	130.3	84.5	--	--	114.3	113.3	142.0	36.3	133.3
Thiram	129.3	141.8	78.0	--	--	135.3	133.0	143.3	75.3	136.0
Vancide 51 ZW	165.5	120.5	77.0	91.8	93.5	135.8	140.0	136.8	57.3	139.0
L.S.D. 5%	34.2	N. S.	16.0	N. S.	N. S.	31.5	19.0	10.2	27.2	26.0
1%	45.8	N. S.	21.5	N. S.	N. S.	42.2	25.8	13.6	36.5	35.4

*Mean of four replicates in each case.

Beet: All treatments resulted in highly significant increases in emergence over the check. The Spergon and thiram treatments, however, resulted in lower emergence than the other fungicides.

Carrot: No significant differences between treatments were shown.

Eggplant: Significant increases in emergence over the check were obtained only with Orthocide 75. Spergon gave a highly significant decrease in emergence.

Pea: No significant differences between treatments were obtained with either variety.

Mustard: All treatments resulted in highly significant increases in emergence, and no differences were evident between fungicides.

Pepper: The Semesan treatment was not significantly different from the check, and the Dow 9 B treatment resulted in a highly significant decrease in emergence. The Spergon treatment resulted in significant increases over the check, while the Arasan, Orthocide 75, Phygon, thiram, and Vancide 51 ZW treatments all resulted in a highly significant increase in emergence.

Radish: The Dow 9 B treatment resulted in a highly significant decrease in emergence. The other treatments were not significantly different from the check.

Spinach: All treatments, with the exception of Orthocide 75, Semesan, and Spergon, resulted in highly significant increases in emergence. Orthocide 75 and Semesan were not different from the check. Spergon resulted in significant increases.

Tomato: None of the treatments resulted in significant increases in emergence over the check. The Dow 9 B and Spergon treatments resulted in a significant decrease in emergence.

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THE EFFICACY OF CERTAIN CHEMICALS AS FUNGICIDES FOR A VARIETY OF FRUIT, ROOT AND VASCULAR PATHOGENS

J. B. Kendrick, Jr., and John T. Middleton[1]

Many of the newly developed chemical materials showing promise as fungicides are recommended on the basis of their performance in laboratory spore germination tests against standard fungus species such as Sclerotinia fructicola, Alternaria oleracea, Glomerella cingulata and others (1). Spore germination tests often indicate potential effective materials but do not provide enough specific information concerning their scope of effectiveness when placed in soil. Laboratory tests must be devised to screen chemicals adequately before field tests are made. Most investigators concerned with chemical control of soil-borne fungi have developed their own screening tests for the specific organisms with which they are dealing. Arndt (2) has recently described a laboratory technique for evaluating the efficacy of fungicides mixed with soil in preventing infection of cotton by Rhizoctonia solani. Zentmyer (3) has described a laboratory technique for evaluating fungicides to be applied to the soil as drenches. The successful material in this case is not only an effective fungicide but in addition is capable of moving through soil in moisture.

The present study was designed to test the fungicides listed listed in 1 against a wide variety of soil-borne pathogens and against some citrus and tomato fruit pathogens.

Table 1. Materials used, their chemical composition, and name of supplier.

Material	Chemical composition	Supplier
captan	N-trichloromethylthio tetrahydrophthalimide	Calif. Spray Chemical Corp.
nabam	disodium ethylene bisdithiocarbamate	Rohm & Haas Company
thiram	tetramethyl thiuramdisulfide	DuPont Company
Vancide 51W	sodium salts of dimethyl dithiocarbamic acid and 2-mercaptobenzothiazole	R. T. Vanderbilt, Company, Inc.
Vancide ZW	zinc salts of dimethyl dithiocarbamic acid and 2-mercaptobenzothiazole	R. T. Vanderbilt, Company, Inc.
16030	---	FarbenFabriken Bayer
856	---	Carbide & Carbon Chemical Corp.
974	3, 5-dimethyl-tetrahydro- 1,3, 5-2H-thiadiazine-2-thione	Carbide & Carbon Chemical Corp.
275	pentachloronitrobenzene	Mathieson Chemical Company
1194	chlorinated nitrobenzene	Mathieson Chemical Company
1197	chlorinated nitrobenzene	Mathieson Chemical Company
N-521	3, 5-dimethyl-tetrahydro-1, 3, 5-2H-thiadiazine-2-thione	Stauffer Chemical Company

[1] The authors wish to express their appreciation to John Paul Delvaille and Michael Treshow for their assistance in this investigation.

MATERIALS AND METHODS

The eight root rotting fungi used were: Fusarium solani f. phaseoli, Pythium aphanidermatum, P. ultimum, Phytophthora citrophthora, P. cinnamoni, Rhizoctonia solani, Sclerotinia sclerotiorum, and Sclerotium rolfsii. The two incitants of vascular wilt in tomato tested were: Fusarium oxysporum f. lycopersici and Verticillium albo-atrum. The fruit pathogens tested were: Alternaria solani, Botrytis cinerea, Fusarium roseum, Pleospora lycopersici, and Penicillium digitatum.

The tests were conducted in two steps. The first step consisted of testing the fungicidal and fungistatic levels of the materials at concentrations of 10, 100, and 1000 parts per million (p.p.m.) by weight of the active ingredient in potato dextrose agar[2]. The second step consisted of testing the more promising materials with Zentmyer's soil drench test (3), against all or selected representatives of the root rot- and wilt-inciting organisms.

In the first step, disks 5 mm. in diameter cut from the margins of an actively growing fungus culture were placed with the fungus surface downward on potato dextrose agar plates containing the suspended chemical at one of the given concentrations. Three plates, each containing four inoculations, were used for each concentration and each fungus species. Records were taken on a given species when the radial mycelial growth reached a maximum in control plates. Fungistatic concentrations were noted where growth occurred only on the inoculum piece and radial growth was completely inhibited.

The soil technique described by Zentmyer was used in step 2 of the test. Disks 5 mm. in diameter were cut from an actively growing mother culture and placed on top of 10 grams of sterile soil in a small glass vial. An additional 10 grams of the same soil was added to cover the inoculum. Test materials were prepared in concentrations of 10, 100, and 1000 p.p.m. of the active ingredient by weight in water suspensions. Five milliliters of the prepared chemical suspensions were added to the soil containing the inoculum. This amount of liquid was sufficient to completely wet the entire soil column. The inoculum was retrieved at the end of a 24-hour incubation at room temperature (approximately 24° C), and placed on potato dextrose agar plates. The effectiveness of treatment was determined after the control inoculum blocks showed growth.

RESULTS

The results, summarized in Table 2, show that the fungicidal or fungistatic concentrations for most materials vary depending upon which fungus was used as the test organism. Mathieson compounds 1194 and 1197, inhibiting fungus growth at 10 p.p.m., were the most consistently effective compounds in agar plate tests against a variety of fungi. Mathieson compound 275 was equally effective against Rhizoctonia solani, Sclerotinia sclerotiorum, and Pleospora lycopersici, but was rather ineffective against other fungi in the test. The effectiveness of these compounds was either lost completely or greatly reduced when tested in the soil screen against the same fungi.

Bayer compound 16030 was almost as effective in the agar plate test as Mathieson compounds 1194 and 1197. However, it failed to show up well in the soil drenching test against Rhizoctonia solani and Sclerotinia sclerotiorum.

Stauffer compound N-521 was consistently effective at 100 ppm concentration against all the organisms tested except Penicillium digitatum in both the agar plate and soil testing screens.

Vancide 51W and ZW, nabam, captan, and thiram showed considerable variability in fungistatic and fungicidal concentrations against the organisms tested in the agar plate test. Only nabam exhibited any consistent fungicidal properties in the soil screen, being fungicidal at 1000 ppm concentration against nearly all of the test fungi.

Compounds 856 and 974 did not show sufficient effectiveness in the agar plate screen to warrant additional testing in the soil screen. This response was somewhat unexpected with compound 974 since chemically it is the same as compound N-521. The physical appearance of 974 was different than N-521. Different formulations of these two chemicals could possibly explain their variation in the tests.

DISCUSSION AND SUMMARY

Stauffer compound N-521 was the most outstanding of the 12 materials tested in this series of tests showing fungicidal properties at 100 ppm concentration against a wide variety of organ-

[2] Difco brand of potato dextrose agar with 2 grams of yeast extract added per liter.

Table 2. Results of fungicide toxicity tests showing the most effective concentration of active ingredient in P.P.M.

Organism	Materials																									
	16030		captan		856		974		nabam		275		1194		1197		N-521		thiram		Vancide 51 W		Vancide ZW	
	P	S[a]	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S
Fusarium solani f. phaseoli	x[b]		m		0		M		M	M	0	0	x		x		C		C				M	0	M	
Pythium aphanidermatum	x		m	0	0		C		C	M	0	0	x		x			C	C	C	0		C	M	m	0
P. ultimum	x		M		0				C	M	m	0			x		M		C	C			M	M	M	
Phytophthora citrophthora					M				C	M		0						C	C				c	M	M	
P. cinnamomi									c	M		0							C	C			c	0	M	
Rhizoctonia solani	c	0	c	0	0		M		M	M	x	0	x	0	x		C		C	C	0		C	M	M	0
Sclerotinia sclerotiorum	c	0	c	0	0		c		x	M	x	0	x				M		C	C	M		C	M	c	C
Sclerotium rolfsii	x		c	0	0				x	M	c	0			x				C	C	M		M	M	x	0
Fusarium oxysporum f. lycopersici			c	0	0				C	M	0	0		0	x		M		c	C			M	0	M	M
Verticillium albo-atrum	c		m	0	0		M		C	M	c	0	x		x		M		C	C	M		c	M	M	M
Alternaria solani			m		0				m	M	m	0	x		x			C	C	M			M	0	M	
Botrytis cinerea			M		0				M	M		0	X		x				C	c			M	M	c	
Fusarium roseum			m		0				m	M	0	0						C	C	M			M	0	M	
Pleospora lycopersici			c		0		c		0	M	x	0	x		x			c	C	M			M	0	M	
Penicillium digitatum									0		0							M		M			x		m	

[a] P = agar plate test, S = soil drench test.

[b] Capital letters = fungicidal concentration, small letters = fungistatic concentration, 0 = no growth suppression, x or X = 10 ppm, concentration, c or C = 100 ppm, and m or M = 1000 ppm.

isms in both the agar plate and soil screens. Compound 1197 showed more effectiveness in agar plate tests than N-521; however, it was less effective when applied to the soil as a water drench. Since only those compounds which are able to move through the soil in a water phase will satisfactorily pass this soil test, it is not surprising to find discrepancies between effective concentrations of compounds tested in agar plates and in soil drenches. The fungicidal principle of compound N-521 is apparently able to move through the soil in water.

The two water-soluble materials nabam and Vancide 51W were consistantly effective in soil against a wide variety of fungi but only at 1000 ppm concentration. None of the other compounds appear to offer any promise as a soil fungicide when applied to soil as a water drench.

It is of interest to note the specific effectiveness of compound 275 against two important soil inhabiting organisms, Rhizoctonia solani and Sclerotinia sclerotiorum. The material apparently acted against these two organisms as a fungistat but not as a fungicide at 10 ppm. It showed no effectiveness against two other important groups of soil inhabiting fungi, namely Pythium spp. and Fusarium spp. The soil drenching screen showed that this compound would not move in a soil solution and, therefore, would probably be effective against Rhizoctonia solani and Sclerotinia sclerotiorum, only if mixed in the soil. Arndt (2) has shown that 275 is effective at 50 ppm against Rhizoctonia solani when it is incorporated into the soil by mechanical mixing.

The use of these two types of screens against a wide variety of organisms reveals several facts of interest concerning these chemical materials. First, most of the chemicals do not perform in a similar manner against different types of fungi. Only Stauffer's N-521 and Mathieson's 1194 and 1197 were consistent in this respect. Secondly, concentrations of some materials which are effective in preventing fungus growth in agar plates are not effective in a soil medium. This is more surprising with the water soluble materials, nabam and Vancide 51 wettable, than with the other relatively insoluble materials. N-521 is a notable exception since it proved to be equally fungicidal in agar plates and in soil. Thirdly, compound 275 shows specific effectiveness against only two important soil borne pathogens in vitro and would not be considered as having promise in preventing a wide variety of diseases. One might expect that N-521, on the other hand, would have a good possibility of successfully controlling a number of fungus diseases. And, finally, information is provided concerning methods of applying materials to soil for the maximum success. For example, N-521 could be expected to perform well if applied to the soil surface and watered in by rain or irrigation waters. On the other hand, Mathieson 275, 1194, and 1197, handled in this manner, would probably be very ineffective. These materials may prove very successful fungicides in soil if mechanically incorporated.

Screening a wide variety of fungus parasites by several methods provides more extensive information concerning the potentialities of a given compound than could be accumulated through exhaustive field tests by a number of investigators in several different locations. The broad laboratory screen allows a critical evaluation of compounds and increases the probability of success in field trials.

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THIELAVIOPSIS ASSOCIATED WITH ROOT ROT OF SOME ORNAMENTAL PLANTS

John R. Keller[1] and Howard S. Potter[2]

Thielaviopsis basicola (Berk. & Br.) Ferraris has been the cause of root rot of tobacco in Maryland for years. More recently greenhouse poinsettias have been severely damaged by this fungus. Although T. basicola has a wide host range, it has not been reported to have damaged other florist crops in Maryland. However, within the past few months Thielaviopsis root rot has been found on several crops of which some have not been reported before to be attacked by this fungus.

A severe case of cyclamen (C. persicum Mill) root rot was found in a greenhouse in Baltimore County. In this case soil from poinsettia stock plants which were infected with T. basicola had been used in the potting mixture and in addition the pots were set on benches previously used for poinsettias. The plants were stunted and the leaves were distorted and yellow around the margins. In 1895 cyclamen was reported by Sorauer[3] to be susceptible. Abundant mycelium and barrel-shaped chlamydospores typical of T. basicola were found in the root tissue by microscopic examination and the fungus was isolated from the roots on carrot slices following the technique suggested by Yarwood[4]. From the same greenhouse and one other source begonias (B. semperflorens Link & Otto) were noticed to be lacking in vigor and to have an unusual number of yellow leaves. The roots were found to be moderately infected with T. basicola. Susceptibility of begonias had previously been reported by Selby[5].

From a greenhouse in Frederick, Maryland, several specimens of scindapsus (S. aureus Engler) were received which had lost almost all roots due to rot. T. basicola was observed in the root tissue and was isolated on carrot. However, Rhizoctonia also was isolated from tissue plants on agar so that both organisms could have been involved. Numerous chlamydospores of Thielaviopsis present in the roots indicated that this fungus could have been largely responsible.

In the University of Maryland greenhouses cinerarias (Senecio cruentus DC.) exhibited stunted growth, chlorosis, rolling of the upper leaves, and reduction in flower size and number. Thielaviopsis was readily isolated from the roots on carrot slices. The root rot gradually developed on the maturing plants over a period of several months. In the same greenhouses foliage of gerbera (Gerbera jamesonii Bolus) showed chlorosis and dieback. Again T. basicola was isolated from the roots.

This is believed to be the first report of T. basicola associated with root rot of scindapsus, cineraria, and gerbera. Healthy seedlings of these species are being tested under controlled conditions to confirm pathogenicity of Thielaviopsis.

In March 1953 400 dormant two-year-old Wisconsin-grown American elm trees (Ulmus americana L.) were planted in a sand-filled, sub-irrigated greenhouse bench. Complete nutrient solution was supplied twice every 24 hours after the trees began to grow. The elms thrived until early in June when some leaf chlorosis appeared. Six weeks later all except the youngest leaves were yellow. This was followed by browning of the leaf edges, necrotic leaf spotting and shot holing and finally complete defoliation of most of the trees. When the trees were removed the entire branch root system in every case showed symptoms of advanced root rot. Root discoloration ranged from light tan to black and most of the lower roots had separated from the plants prior to removal. (Figure 1).

Microscopic examination of the roots from a 10 percent random sample of the infected trees consistently revealed the presence of a complex of fungus organisms. The most prominent signs were various thick-walled oöspores resembling those produced by either Phytophthora or

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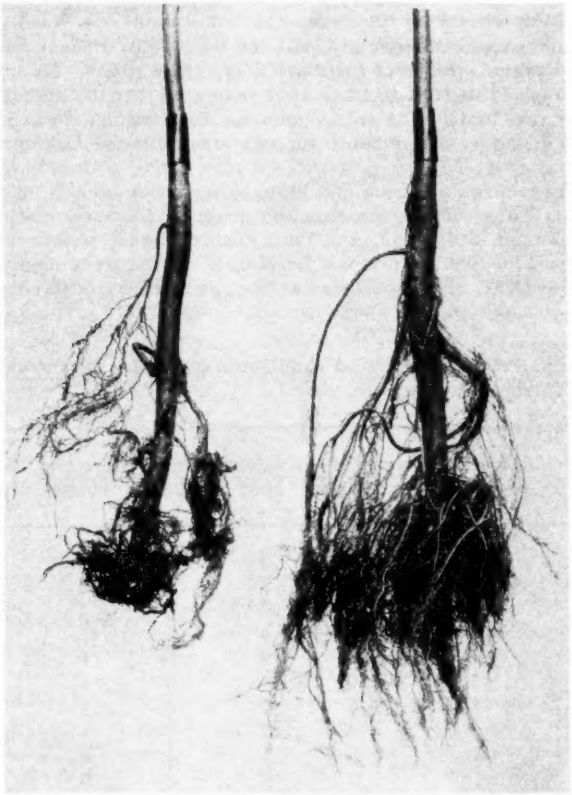

FIGURE 1. Healthy (right) and severely rotted roots (left) of elm seedlings.

Pythium, chains of dark barrel-shaped spores tentatively identified as the chlamydospores of Thielaviopsis basicola, and masses of intercellular mycelium.

Species of Pythium and Rhizoctonia were isolated in every instance from the diseased root tissue. Attempts to isolate a Phytophthora were unsuccessful. The presence of T. basicola in 100 percent of the infected roots sampled was verified by isolating the organism on carrots.

Since this is the first case noted of T. basicola associated with root rot of elms, experiments have been set up to determine whether Thielaviopsis is a primary parasite of elm seedlings.

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THE PRESENT STATUS OF DUTCH ELM DISEASE IN ILLINOIS

Richard J. Campana

Since its first occurrence in Illinois in 1950[1] the Dutch elm disease had become widely distributed in the southern two-thirds of the State (Fig. 1) by 1952[2]. Its increase in Champaign-Urbana from two cases in 1951 to 11 in 1952 indicated that the disease might become well established in future years, and a substantial increase was anticipated in 1953 because of the large numbers of elms killed by the phloem necrosis virus disease, which had been allowed to remain standing.

During 1953, 495 new cases of Dutch elm disease were detected in 28 localities in 12 counties (Table 1) of the State. Of the six counties in which diseased trees were found for the first time, Crawford, Edgar, Jefferson, and Piatt (Table 1) were within the general area of distribution of the disease in 1952. Ford and Iroquois Counties were north of the general area of disease distribution in 1952. Infected trees at Onarga in Iroquois County were about 80 miles from Chicago.

Table 1. Number of trees affected with Dutch elm disease (Ceratostomella ulmi) in Illinois by county and year.

County	Localities per county	Trees affected each year				Total trees affected
		1950	1951	1952	1953	
Champaign	11	0	4	17	183	204
Coles	3	1	1	0	233	235
Crawford	1	0	0	0	1	1
Douglas	3	0	5	2	42	49
Edgar	1	0	0	0	9	9
Ford	1	0	0	0	1	1
Iroquois	1	0	0	0	2	2
Jefferson	1	0	0	0	1	1
Lawrence	1	0	1	0	2	3
Macon	1	0	0	2	0	2
Marion	3	0	0	1	15	16
Massac	1	0	0	1	5	6
Piatt	1	0	0	0	1	1
Pulaski	1	0	0	1	0	1
Vermilion	1	0	0	1	0	1
Total	31	1	11	25	495	532

In 1953 diseased trees were located in counties as follows: 183 in Champaign; 233 in Coles; 42 in Douglas; 9 in Edgar; 2 each in Iroquois and Lawrence; 15 in Marion; 5 in Massac; and 1 each in Crawford, Ford, Jefferson, and Piatt. In about half of the cases, confirmation of Dutch elm disease was made by culturing the fungus. Confirmation by culture was made for every county and for every community remote from established centers of infection. Field diagnoses were made from foliage symptoms and discolored sapwood of trees nearby those from which confirmation by culture was obtained.

As anticipated, the greatest increases in numbers of diseased trees occurred in those counties (Coles, Champaign, Douglas) with oldest known cases of infection. Substantial spread and increase of the disease in 1953 occurred in all such counties except Lawrence (Table 1). In

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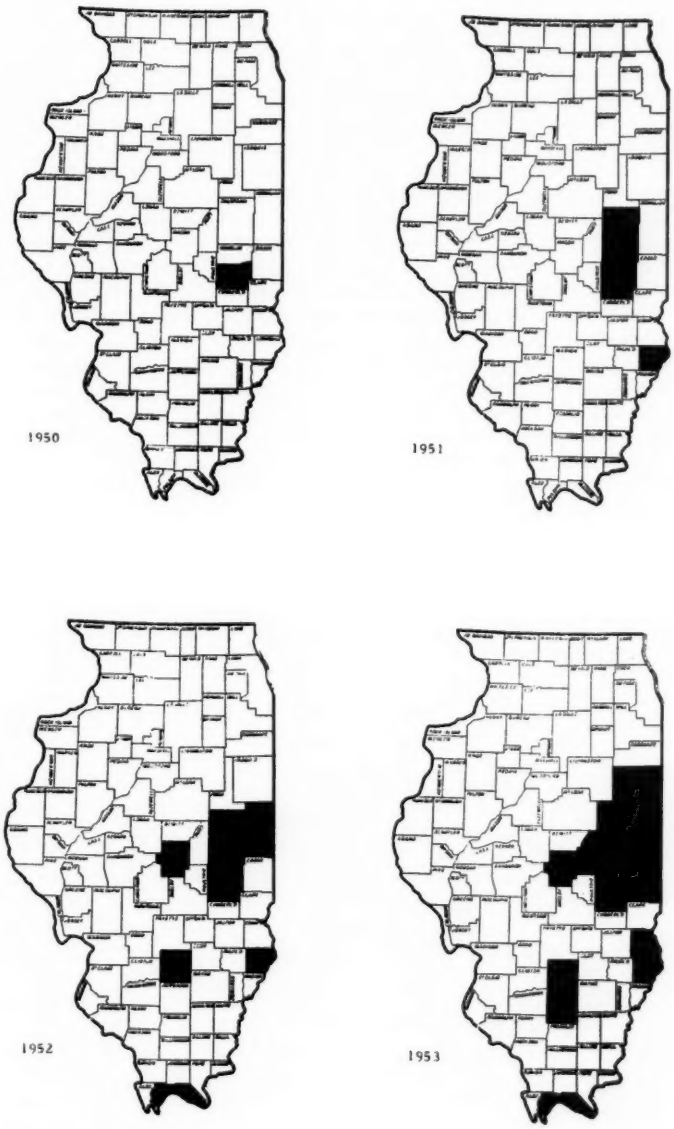

FIGURE 1. Known distribution of the Dutch elm disease in Illinois, by county, indicating spread each year.

Coles County the increase from 1 case in 1950 to 233 in 1953 was spectacular. That the incidence of phloem necrosis has been and is currently high in that area seems significant.

Since most cases of Dutch elm disease in Illinois have occurred within the general area of distribution of phloem necrosis (the southern two-thirds of the State), rapid spread and intensification of Dutch elm disease where phloem necrosis occurs has been anticipated. Since most of the diseased trees reported here were detected incidentally rather than by systematic survey, and since some of the areas affected are widely separated, it is probable that many more diseased trees may occur in localities intervening between reported diseased areas. It is apparent from Fig. 1 that a definite pattern of spread is developing in east central Illinois.

In Champaign-Urbana, where the incidence of both the Dutch elm disease and phloem necrosis has been studied intensively, the cases of Dutch elm disease increased from 11 in 1952 to 173 in 1953. In spite of the relatively few diseased trees discovered in 1952 the Dutch elm disease fungus was cultured from 8 of 40 trees sampled that had been killed by phloem necrosis, demonstrating clearly the danger involved in the accumulation of dead elmwood resulting from the effect of phloem necrosis. The abundance of dead elm material in Champaign-Urbana from the effect of phloem necrosis for several years has undoubtedly contributed to the rapid increase of Dutch elm disease in this community.

During the summer of 1953 intensive feeding of elm bark beetles on healthy elms in established areas of phloem necrosis was conspicuous by the occurrence of hundreds of brown, twig flags over whole trees unaffected by either Dutch elm disease or phloem necrosis. Examination of these twigs showed clearly that the damage was caused by large numbers of European elm bark beetles feeding in crotches of elm twigs. Such abundant and conspicuous feeding indicates the tremendous increase in the population of the bark beetle carrier, which can be expected where abundant elm wood is available for breeding.

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RECOVERY OF ISOLATES OF ENDOCONIDIOPHORA FAGACEARUM FROM OAK TREES FOLLOWING MIXED CULTURE INOCULATIONS[1]

H. L. Barnett and Frederick F. Jewell

During the past two years, there has been an accumulation of evidence that only one compatibility type of the oak wilt fungus, Endoconidiophora fagacearum Bretz, survives in the great majority of naturally infected trees. Both compatibility types have been found in only a few trees in nature. Only two of 43 West Virginia trees, sampled in 1952, yielded both A and B types (1). Similar findings were made by Boyce and Garren (3), who isolated both types from only one of 23 trees sampled in North Carolina and eastern Tennessee in 1952. Hepting, et al. (6) had previously reported one tree containing both types. Fergus (5) isolated from 20 mycelial mats from each of six trees, and found only one compatibility type present on each of the trees. Type A was recovered from four trees and type B from two trees.

Results of this nature have been considered as evidence that in very few cases do the perithecia result from the intermingling of mycelium of opposite compatibility types or from spermatization between mats on the same tree (1, 5).

The formation of perithecia on mycelial mats is usually the result of the transfer of spores from mats of the opposite compatibility type on nearby trees. The same insects, such as the Nitidulids, that serve in the spermatization process (7), visiting mats that have already produced perithecia, are the most likely vectors, carrying ascospores and conidia to wounded trees (4).

However, it is not known what percentage of the inocula in nature contains both type A and type B spores, and it had been assumed that if spores of both types were introduced into an oak tree at the same point, it should be possible to reisolate both types from all samples of the diseased tree. Valid information on the survival of one or both spores can be obtained only by artificial inoculation studies. Some information of this sort was obtained in 1952 by Barnett and Staley (1), who recovered only one compatibility type from five of six trees inoculated with mixtures of A and B spores, either ascospores or conidia.

The number of trees used in the 1952 experiments was too small to give conclusive results, and it was decided to inoculate a greater number of trees in 1953. A total of 70 red and black oak trees, measuring 1 to 4 inches in diameter, were artificially inoculated with conidial suspensions from single cultures or a mixture of two or four cultures. This paper reports the results of isolations from these trees.

The cultures used were all derived from West Virginia isolates of 1951 or 1952. It was the good fortune of the authors to isolate from a dark culture (No. 645), a white mutant which proved to be a heavily sporulating, highly pathogenic albino. In all appearances and in sexuality, this isolate was like the albino later isolated from a tree in nature (2). When this albino was crossed with a dark isolate, both dark and albino F_1 cultures were obtained in equal numbers. The albino mutant and the F_1 albinos were excellent cultures to use with dark cultures in mixed conidial inoculations, since the isolates recovered from the trees could be recognized as dark or albino when only a few days old. All isolates used were proved to be pathogenic by single-culture inoculations of three trees each.

Conidial suspensions, containing approximately equal numbers of spores, were made from each culture, and mixed in the desired combinations before inoculation into chisel wounds made in the tree trunks. Inoculations were made on July 23 and 24, 1953. Trees showing oak wilt symptoms between August 20 and September 22 were cut and six samples were taken from each tree, one below the point of inoculation and five branch or trunk samples from different parts of the tree above that point. For some undetermined reason, perhaps the extreme drought during late summer, nearly half of the trees failed to show symptoms before fall coloration of leaves began. Thirty-six trees were cut and sampled. Ten chips from each sample were cut and placed on maltose-Casamino Acids agar in Petri dishes.

While the white and dark isolates were easily distinguishable a few days after isolation, it was necessary also to determine the compatibility type of those isolates recovered from trees inoculated with a mixture of conidia from two white and two dark cultures. This was done by crossing isolates from half or more of the positive oak chips with cultures of known A and B

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Table 1. Recovery of isolates of Endoconidiophora fagacearum from red and black oak trees inoculated with mixed isolates. F_1 cultures were single-ascospore isolates from the cross 645 mutant[1] albino X2065. A and B = compatibility types.

Isolates in mixed inoculum	No. of trees	No. positive chips and isolates recovered
645 (dark B), 645 mutant (white B)	4	99 white B
645 mutant (white B), 2065 (dark A)	1	21 white B, 4 dark A, 11 mixed
	3	73 white B
F_1 (dark A), F_1 22 (white A)	1	20 white A
	1	38 dark A
F_1 3 (dark B), F_1 24 (white B)	1	22 white B, 6 dark B, 4 mixed
	1	14 dark B
	2	39 white B
F_1 1 (dark A), F_1 3 (dark B), F_1 22 (white A), F_1 24 (white B)	1	17 dark B
	2	59 dark A
	1	23 white B
	1	2 white A, 10 dark A
	1	1 white A, 10 white B, 2 dark A

types.

In general, the recovery of the fungus from the samples was quite irregular. Six of the 36 trees sampled failed to yield the fungus. It was recovered from below the point of inoculation from only seven trees. It was isolated from four or more samples from 21 trees. Two or more of the isolates used for inoculation were recovered from only four trees. From two trees, the dark and white mycelium grew out from some of the same chips (termed here, mixed isolates), as well as from separate chips and different samples. From one tree, the white isolate was recovered from below the point of inoculation, and the dark isolate from above that point. Three isolates were recovered from only one tree inoculated with a mixture of four isolates; dark A was isolated from one sample, while white mycelium was isolated from other samples. A summary of the recovery of isolates from trees inoculated with mixed cultures is presented in Table 1. Ten diseased trees which had received single culture inoculum are not reported in the table.

The albino mutant and the F_1 albino cultures proved to be a very useful tool in the study of survival of isolates in the trees. It not only eliminated the need for testing isolates for compatibility types when only two cultures were used as inoculum, but also made it possible to use a mixture of spores from four cultures, each culture being identifiable by color or by cross spermatization when it was recovered from diseased trees. The frequency with which the albino isolates were recovered is sufficient proof of their high degree of pathogenicity. While No. 645 mutant albino was recovered more often than culture 2065 from trees receiving both isolates, there was no indication that a factor for survival was inherited with either color or compatibility type.

Both isolates were recovered from only two trees which had received mixed inoculum of two cultures, while in the six trees receiving mixtures of four cultures, only one isolate was recovered from four trees, two from one tree, and three from one tree. These results clearly show that following mixed inoculations, certain factors are operating which, in the majority of cases, lead to the survival of only one isolate.

These general conclusions are the same as those reached following the limited 1952 experiments (1). The significant point is that strikingly similar results were obtained in 1953, using a greater number of trees, a greater number of isolates (including albinos) as inoculum, and a mixture of four isolates as inoculum for some trees. These results, therefore, are considered as strong supporting evidence for the validity of the hypothesis that, as a result of chance or competition, one isolate in the mixed inoculum frequently becomes established in the tree more quickly, and only this isolate can be recovered from the diseased tree. In a smaller percentage of trees receiving mixed inoculum, more than one isolate survives and can be recovered. In nature, the inoculum would likely be a mixture of conidia or ascospores of A and B compatibility types.

The results also support the hypothesis that under natural conditions, the production of perithecia is usually the result of spermatization of fungus mats by spores of the opposite compatibility type. Without spermatization, which is believed to be carried out principally by insects (4, 7), perithecia can be formed only on trees in which both compatibility types of the fungus are present, and are close enough together to intermingle in mat formation. Our data indicate that this is seldom the case.

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DISEASES AND INSECTS AFFECTING THE COMMONLY PLANTED TREES AND SHRUBS IN GEORGIA

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During the past decade thousands of houses and other buildings have been constructed throughout Georgia. This boom in construction has creasted an increased demand for shade trees and ornamental shrubs, resulting in numerous inquiries concerning the suitability of different plants. These inquiries have stimulated this review of the commonly planted trees and shrubs in an effort to evaluate their freedom or susceptibility to disease and insect pests and their general adaptability to Georgia conditions.

The earliest settlers adapted native plants to their needs for shade and ornament, or more often retained those already present on the homesite. Later, in the period preceding the Civil War, Berckman Brothers established one of the first commercial nurseries at Augusta and introduced into cultivation many of the more attractive native plants as well as the now very common Asiatic species. The more desirable ones have persisted and, in addition, many of the ornamentals found in other parts of the country have been introduced. Some require little care while others need constant attention in order to maintain a respectable appearance.

The senior author has been observing ornamental plants in Georgia for more than thirty years. This period covered several noteworthy droughts (1925-26 and 1931-33) as well as other unusual climatic disturbances such as the severe freeze of November 27, 1951. In addition to these damaging climatic variants many diseases and insects new to this region have been introduced during this period. The following report, therefore, will cover the effect of these factors on some of the commonly grown trees and shrubs.

SHADE TREES

Deciduous

Elms: The American elm (Ulmus americana), the cork or winged elm (U. alata), and the Siberian or Chinese elm (U. pumila) are the chief ones planted.

The American elm is at the southernmost limit of its natural range in Georgia and does not grow so vigorously as it does farther north. Street and yard trees are commonly chlorotic and unthrifty especially during the hot summer months. A dieback of undetermined origin characterized by brown streaks in the wood has been present at Athens for a number of years. Over half of the trees in which such symptoms were first observed are now dead. The remaining trees exhibit extreme dieback and are unsightly.

Leafspot caused by Gnomonia ulmea is common, beginning in the middle of the summer. The leaves turn yellow and many are shed prematurely. By the end of August defoliation is often severe.

San Jose scale is widely distributed and causes dieback of limbs. The elm leaf beetle occasionally feeds on American elm, but does not do a great deal of damage.

Phloem necrosis (virus) has been present in Georgia for several years in the area adjacent to Chattanooga, Tennessee. During the summer of 1951 an outbreak of considerable proportion was observed at Lindale and Rome. This outbreak is the largest found in Georgia to date and represents a southward spread of some 50 miles. Trees suspected of having phloem necrosis have been noted in Atlanta and Athens. Apparently it may be only a question of time before the disease becomes widespread throughout most of the northern part of the State.

The cork or winged elm is native to Georgia and is well adapted to soil and climatic conditions throughout most of the state. The most serious trouble is a powdery mildew (Uncinula parvula) which turns the leaves gray, then yellow, from July on. Although the effect on growth is probably negligible it renders the foliage unsightly.

The worst pest of the Siberian elm is the elm leaf beetle which has completely ruined the leaf crop of most of the trees in the Athens area for the past several years. A number of property owners have cut out these elms because defoliation by this beetle spoils the trees for shade purposes. It is also common and severe over much of North Georgia. This one pest makes this elm undesirable as a shade or street tree.

The wood of the Siberian elm is also extremely brittle and branches break badly in the periodic ice storms.

Oaks: These are the chief shade trees of Georgia and comprise at least 90 percent of the trees on streets and around houses. There are about 50 named species indigenous to the State,

but only water oak (Quercus nigra), willow oak (Q. phellos), pin oak (Q. palustris), live oak (Q. virginiana), and laurel oak (Q. laurifolia) are commonly planted. Other species when found are usually survivors of the original vegetation.

Dead and dying oaks are common throughout the State. Both shade and forest trees are affected. Because of the nearness of oak wilt (Endoconidiophora fagacearum) in North Carolina, a survey was conducted throughout the summer of 1951 in cooperation with the Georgia Forestry Commission. Isolations from over 40 trees with symptoms suggestive of wilt failed to produce the fungus responsible for oak wilt. As of this date no oak wilt has been found in Georgia.

In the spring leaf blister (Taphrina caerulescens) is often very severe throughout the State, especially on species of the red oak group. However, white oak, laurel oak, and live oak are at times affected.

Premature defoliation of post oak (Q. stellata) occurs to some extent each year and has been especially noticeable during the last two summers. The cause has not yet been determined.

Of the oaks usually planted along streets, water oak, willow oak, and live oak have withstood droughts much better than southern red oak (Q. falcata), scarlet oak (Q. coccinea), black oak (Q. velutina), or northern red oak (Q. rubra).

For many years dying oaks have been observed along streets and in yards, but no one cause has been associated with the deaths. The chief causes have root poisoning from leaking gas mains, soil compaction, and root cutting following grading with subsequent entry of various wood-rotting fungi.

Maples: The chief maples grown in Georgia are red maple (Acer rubrum), silver maple (A. saccharinum), and Florida maple (A. barbatum). Norway maple (A. platanoides), planetree maple (A. pseudoplatanus), and Japanese maple (A. palmatum) are occasionally planted. The latter exotics are fairly well adapted to the extreme northern region of the State, while the Florida maple does well in the Piedmont and in south Georgia. Red maple and silver maple cannot be recommended. The latter always suffers from severe dieback of even large limbs because of extreme susceptibility to San Jose scale, while red maple in addition to scale breaks up easily during ice storms.

Sycamore: The commonly planted species, Platanus occidentalis, has only one serious trouble and that is a tendency for the leaves to turn yellow and then brown beginning about the middle of the summer owing to lace bug feeding. Anthracnose (Gnomonia veneta) does not appear to be serious on sycamore trees in Georgia.

Southern Magnolia (M. grandiflora): This handsome tree is often planted in yards, especially around old homes. It has withstood severe droughts and cold and has no serious diseases nor insect pests. Spot anthracnose caused by Elsinoë magnoliae and a large leaf spot caused by Glomerella cingulata have been found on some trees.

Sugarberry (Celtis laevigata): The one species has been planted extensively in middle Georgia cities, especially Macon, and thrives well with few or no insect or disease pests. Along the coast it tends to break up during recurrent hurricanes.

Camphor-tree: A single species, Cinnamomum camphora, in recent years has been planted extensively in yards and on streets in extreme south Georgia. The writers have found no serious pests on this species, but the low temperatures, down to 12° F as far south as Tifton, in November 1951, caused severe dieback.

Crapemyrtle (Lagerstroemia indica): This is a small attractive tree that is planted extensively along streets in yards. The 1951 freeze was the first time within this century that it was seriously injured and the effects are still observable. Powdery mildew (Erysiphe lagerstroemiae) usually attacks lower leaves but is never serious. Aphids feed on leaves in the early summer but rarely cause noticeable injury.

Carolina Laurelcherry (Prunus caroliniana): The only native species is an evergreen tree that is often found around old houses and is sometimes used for hedges. It has no serious pests.

Redbud (Cercis canadensis): This is another native which thrives well and has not been injured by low temperatures, and is often used as a yard ornamental. It has no serious insect pests. Cankers caused by Botryosphaeria ribis occasionally attack trees, causing severe die-

back, but the trouble does not appear to be generally distributed throughout Georgia

Mimosa (Albizzia julibrissin): This flowering exotic is grown extensively all over the State except in the extreme northern counties. Mimosa wilt (Fusarium oxysporum f. perniciosum) has destroyed many valuable trees in the past ten years. The disease is now found south to the Florida line. Wilt-resistant selections introduced by the Division of Forest Pathology have grown successfully in areas where trees have died from the disease.

The mimosa webworm, which was introduced only a few years ago, is now a serious pest. By the middle of the summer trees in many parts of the Piedmont became very unsightly. Continued defoliation has been known to cause death.

Dogwood (Cornus florida): A native plant widely grown on streets of all cities and small towns, is most popular. The flowering bracts of individual trees often fail to open completely because of spot anthracnose, Elsinoë corni. Even light infections are sufficient to make the plant unsightly. Leaf spots caused by Septoria cornicola and other fungi develop in August but do little damage. The stem gall insect is often found in trees in woods but is rare in street trees. The dogwood borer is frequently troublesome. Droughts have been the chief causes of dying. Many plants succumb during each severe drought such as the one in the summer of 1951.

Sweetgum (Liquidambar styraciflua): This common native species has been planted in some areas for shade and is often found in yards. A severe dieback of the leader, and sometimes of peripheral branches, has been observed especially in the Athens area and at Columbus and Fort Benning. Trees with such symptoms have also been found along highways in the Piedmont. An internal necrosis goes with this dieback. The cause has not been discovered. This species cannot be recommended for shade purposes because of this disease.

Ginkgo (G. biloba) is well adapted to most of the State and has no serious enemies. There is one tree in Athens that is over one hundred years old and is still thrifty. Only the male trees are recommended for planting, since the females produce undesirable flowers and fruits.

Weeping Willow (Salix babylonica) is often planted but is seriously injured by occasional low temperatures.

Others: Carolina poplar (Populus deltoides) and Lombardy poplar (P. nigra) are sometimes are found near homes, but both break easily in storms and are subject to bacterial wetwood and dieback, the latter commonly caused by Botryosphaeria ribis. Many of the Asiatic trees that were brought over for street and yard planting, such as the tree-of-heaven (Ailanthus altissima), royal Paulownia (P. tomentosa), Chinaberry (Melia azedarach) and others have escaped into the woods, and while occasionally planted have little to recommend them except rapid growth.

Conifers

Pines: Slash pine (Pinus elliotii) has been planted extensively in yards in the Piedmont and the coastal plain, longleaf (P. palustris) is often planted in South Georgia, and shortleaf (P. echinata) and loblolly (P. taeda) are sometimes found in yards of the Piedmont. Slash and longleaf are not recommended above the fall line because of the tendency of the leader to break in ice storms. Rust cankers caused by Cronartium fusiforme are common on loblolly and slash pines. Bark beetles and blue stain (Ceratostomella spp.) often destroy trees in yards. Pitch cankers (Fusarium lateritium f. pini) have been noted on yard trees in Piedmont cities. Tip moth, which kill the apical shoot, has been very common on young shortleaf and loblolly in North Georgia. Littleleaf disease is occasionally found on shortleaf pine in yards but is important only on forest trees.

The native white pine (P. strobus) does not thrive out of the mountains. The frequent droughts and high temperatures of the Piedmont result in poor growth and early mortality. In mountains where it is often found in yards it does well, except for slight injury from the pine bark aphid and occasionally white pine needle blight. In recent years there has been severe flagging (killing of shoots) following an exceptional abundance of aphids feeding on the twigs.

The Himalayan white pine (P. excelsa) is found in city yards of the Piedmont and thrives better than the native species. However, the 1951 freeze killed or severely damaged many trees 50 or more years old.

Table 1. Diseases, injuries, and insects affecting the commonly planted ornamental shrubs in Georgia, and their relative effects on these plants

Species	Disease, injury, insect	Relative effect[a]	General suitability[b]		
			Mountain	Piedmont	Coastal Plain
Abelia grandiflora			Good	Good	Good
Aucuba japonica	Leaf spot (Phyllosticta aucubae)	+	Poor	Fair	Fair
Azalea calendulacea 1, 2, 4, 5	1: Gall (Exobasidium vaccinii)	0	Good	Poor	Poor
	2: Chlorosis	+			
A. indica 1, 2, 3, 4, 5	3: Flower blight (Sclerotinia azaleae)	+	Poor	Good	Good
A. kurume 1, 2, 3, 4, 5			Poor	Good	Good
	4: Thrips	+			
	5: Lacebugs	+			
Buxus sempervirens	Winter injury	+	Good[c]	Good[c]	Good[c]
	Sunscald	+			
	Nectria canker (Nectria spp.)	++			
	Cottony cushion scale	++			
	Leaf miner	+			
Camellia japonica 1, 2, 3, 4, 5	1: Flower blight (Sclerotinia camelliae)	+	Poor	Good[c]	Good[c]
C. sasanqua 1, 2, 3, 4, 5	2: Dieback (Glomerella cingulata)	+	Poor	Good[c]	Good[c]
	3: Budrot (Botrytis cinerea)	+			
	4: Scale	++			
	5: Thrips	+			
Chaenomeles lagenaria	Scale	+	Good	Good	Good
	Aphids	+			
Cytisus scoparius			Good	Good	Poor
Diervilla hybrida			Good	Good	Poor
Elaeagnus pungens			Good	Good	Good
Eriobotrya japonica			Poor	Poor	Good
Euonymus japonica	Scale	++	Poor	Good[c]	Poor

Table 1. Continued.

Species	Disease, injury, insect	Relative effect[a]	General suitability[b]		
			Mountain	Piedmont	Coastal Plain
Exochorda racemosa			Poor	Good	Poor
Forsythia viridissima			Good	Good	Good
Gardenia jasminoides	Canker	+	Poor	Good[c]	Good[c]
	Chlorosis	+			
	Sooty mold (Capnodium spp.)	++			
	White fly	++			
Hedera helix	Thrips	0	Good	Good	Good
Hibiscus syriacus	Rust (Kuehneola malvicola)	+	Good	Good	Good
	White fly	0			
Ilex spp.	Nematodes	++	Good	Good	Good
Jasminum nudiflorum			Good	Good	Good
Ligustrum amurense	White fly	+	Good	Good	Good
L. japonicum	White fly		Good	Good	Good
L. lucidum	White fly		Good	Good	Good
L. ovalifolium	White fly		Good	Good	Good
Lonicera fragrantissima			Good	Good	Good
L. morrowii			Good	Good	Good
L. tatarica			Good	Good	Good
Magnolia soulangeana			Good	Good	Good
Meratia praecox			Poor	Good	Good
Michelia fuscata			Poor	Good	Good
Nandina domestica			Good	Good	Good
Nerium oleander	Oleander scale	++	Poor	Poor	Good
	Cottony cushion scale	++			
Osmanthus aquifolium			Good	Good	Good
O. fragrans			Good	Good	Good
Parthenocissus quinquefolia 1, 2, 3	1: Leaf spot (Guignardia bidwellii)	+	Fair	Fair	Fair
P. tricuspidata, 1, 2, 3	2: Lacebugs	+	Fair	Fair	Fair
	3: Red spider	+			

Table 1. Continued

Species	Disease, injury, insect	Relative effect[a]	General suitability[b] Mountain	Piedmont	Coastal Plain
Philadelphus coronarius			Fair	Fair	Poor
P. inodora			Fair	Fair	Poor
Phoenix canariensis	False smut (Graphiola phoenicis)	0	---	---	Good
	Scale	+			
Photinia serrulata	1: Powdery mildew	++	Fair	Fair	Fair
1, 2, 3	2: Black spot in nurseries				
P. glabra 2, 3 b	3: Oriental fruit moth	++	Good	Good	Good
Pittosporum tobira	Cottony cushion scale	++	---	Good	Good
Pyracantha coccinea	Scab (Fusicladium pyracanthae)	+	Good[c]	Good[c]	Good[c]
	Lacebugs	++			
Pyrus angustifolia	Rust (Gymnosporangium globosum, G. juniperi-virginianae)	+	Good	Good	Good
Prunus spp.	Leaf curl (Taphrina deformans)	++	Good[c]	Good[c]	Good[c]
	Scale	++			
	Peach borer	++			
Rhododendron catawbiense	Bud blight (Briosia azaleae)	+	Good	---	---
R. maximum			Good	---	---
Rosa spp.	Crown gall (Agrobacterium tumefaciens)	++	Good[c]	Good[c]	Good[c]
	Powdery mildew (Sphaerotheca pannosa)	++			
	Black spot (Diplocarpon rosae)	++			
	Stem cankers	+			
	Aphids	+			
	Thrips	++			
Spiraea spp.	Aphids		Good	Good	Good
Syringa persica			Good	Good	Good
S. vulgaris	Powdery mildew (Microsphaera alni)		Fair	Poor	Poor

Table 1. Continued

Species	Disease, injury, insect	Relative effect[a]	General suitability[b]		
			Mountain	Piedmont	Coastal Plain
Thea sinensis	White fly	0	---	Good	Good
Thuja orientalis	Bagworm	+	Good	Good	Good
	Red spider	+			
Viburnum opulus			Good	Good	Good
V. tomentosum			Good	Good	Good
V. tinus			Fair	Good	Good
Vitex agnus-castus			---	Good	Good
Wisteria sinensis			---	Good	Good

[a] 0, little or no damage; moderate effect on growth or appearance; ++, severe injury, plant rendered unsightly or partially killed.

[b] Good, plant well adapted to soil and climate and relatively free from serious disease or insect pests. Fair, plant either imperfectly adapted to soil or climate or little to moderate damage from disease or insects. Poor, plant either poorly adapted to soil or climate or severely injured by disease or insects.

[c] Good, if given proper attention to control insects and diseases.

Junipers: Redcedar (Juniperus virginiana) is often planted in yards. Rusts caused by Gymnosporangium spp., especially those that attack the branches and trunk, cause some injury. G. globosum also causes the serious rust found on leaves of the commonly planted crabapple (Pyrus angustifolia). A root rot caused by Fomes annosus kills some redcedars each year.

The exotic junipers such as varieties of Juniperus communis are often planted, but do not thrive because of frequent droughts and high temperatures. The bagworm is sometimes a serious pest on all junipers.

Deodar Cedar (Cedrus deodara) is an exotic that has been planted extensively all over the State. It grows well for a few years and then sooner or later the leader is likely to be killed by winter injury followed by fungi or borers. Also, large lateral limbs often show winter cracking followed by borers. This tree is not completely adapted to Georgia conditions.

Other conifers commonly planted in northern States such as Norway spruce (Picea abies), northern arborvitae (Thuja occidentalis), Italian cypress (Cupressus sempervirens), are planted in Georgia but are not well adapted except in the mountain region.

ORNAMENTAL SHRUBS

Although a large number of plant species have been used for ornamental purposes in Georgia those listed in Table 1 are the ones most commonly planted. The diseases and insect pests given for each species are the ones that attract the most attention and cause the most damage under Georgia conditions.

PLANT PATHOLOGY DEPARTMENT, UNIVERSITY OF GEORGIA, AND U. S. FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE, ATHENS, GEORGIA

NEW RECORDS AND OTHER BRIEF NOTES ON PLANT DISEASES

POTATO CALICO ON CHENOPODIUM ALBUM

By Donald Folsom

The natural occurrence of potato calico in Maine 1949-1952 has been reported[1]. Infected potato stock was grown in the field in a short row in 1953. Among plants of Chenopodium album growing up among the potato plants, some developed symptoms identical with those of calico in the potato plants (Fig. 1.).

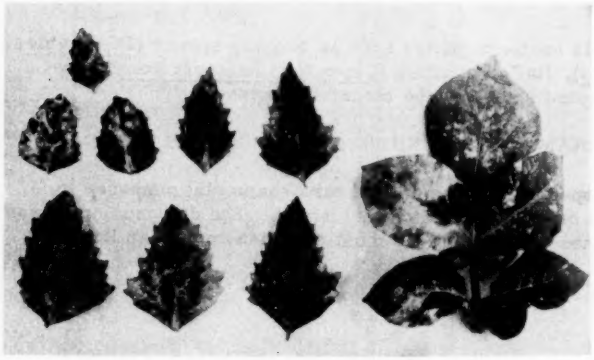


FIGURE 1. Leaf of potato plant with calico, and symptoms on leaves of Chenopodium album rooted in the same soil as the potato plant.

The literature so far lists only species in the Cucurbitaceae, Leguminosae, and Solanaceae as susceptible to the potato calico virus.

MAINE AGRICULTURAL EXPERIMENT STATION, ORONO, MAINE

[1] Folsom, Donald. Potato calico in Maine. Plant Dis. Reptr. 37: 347. 1953.

CRAZY TOP OF CORN IN NEW YORK

By C. W. Boothroyd and D. A. Roberts

Crazy top of corn[1] was observed for the first time in New York State on September 18, 1953. Approximately 50 percent of the plants were found diseased in a five-acre field of corn growing in Limestone, Cattaraugus County. Specimens sent to Dr. Arnold J. Ullstrup, Purdue Agricultural Experiment Station, Lafayette, Indiana, were diagnosed as crazy top.

Proliferations in the tassels of the corn resulted in overgrowths the size of a man's head. The weight of these structures pulled many of the plants down to the ground. Very few mature ears were present on diseased plants, the cob and kernels being replaced by leafy tissue. A few plants were found severely stunted.

The grower reported that this particular field was under water for five or six days when the corn plants were about six inches high. No symptoms of crazy top were observed in another field of corn planted with seed from the same lot. This field was located on higher ground and was not flooded with water.

CORNELL UNIVERSITY, ITHACA, NEW YORK

[1] Ullstrup, Arnold J. 1952. Observations on crazy top of corn. Phytopath. 42: 675-680.

EXPERIMENTAL FORECAST OF WHEAT LEAF RUST IN OKLAHOMA

By H. C. Young, Jr. and D. F. Wadsworth

On April 1, 1953, only a few pustules of leaf rust of wheat (Puccinia rubigo-vera tritici) could be found in the entire State. Trace amounts did appear by harvest time, but damage to the crop was negligible. The forecast for less than 1 percent damage was essentially correct.

General heavy rains during the summer of 1953 provided ample soil moisture for seeding wheat, and in the fall the 1954 crop came up to good stands and made good growth. Additional moisture and warm temperatures in October and November established almost "normal" amounts of leaf rust over the State by mid-December. It is noteworthy that even stem rust (P. graminis tritici) appeared in quantity in some sections at that time, which is unusual and indicates that conditions were very favorable for rust development.

Since early December, however, there has not been a general wetting period suitable for infection by leaf rust. The older leaves carrying the pustules have died and pustule counts on the susceptible variety Cheyenne at Stillwater have declined from a total of 500 per 1000 tillers on January 1 to only 2 per 1000 tillers on March 31.

A survey of the wheat growing areas of Oklahoma covering 2300 miles was made the last week in March. It was found that while some rust was present through the central portion of the State as far north as Okeene, the number of pustules was less than normal for that time of year. The eastern, northern, and western sections of the State were free of rust.

Consequently, the loss from leaf rust in the 1954 wheat crop is expected to average about 1 percent; somewhat higher than last year, but still considerably less than the long-time average annual loss of approximately 5 percent.

As usual, susceptible varieties in low areas, and particularly late fields, will bear the brunt of the damage.

OKLAHOMA AGRICULTURAL EXPERIMENT STATION, STILLWATER, OKLAHOMA

A CORRECTION

R. A. Hyre calls attention to some errors in his article on late blight forecasting in the April 15 issue, pp. 245-253.

On page 245, line 7 from the bottom, the word is "excepting" instead of "expecting".

On page 249, line 3, a line is missing. The missing part is here underscored: The greatest accuracy of forecasts, 83 percent, occurred with a requirement of 10 consecutive favorable days, etc.

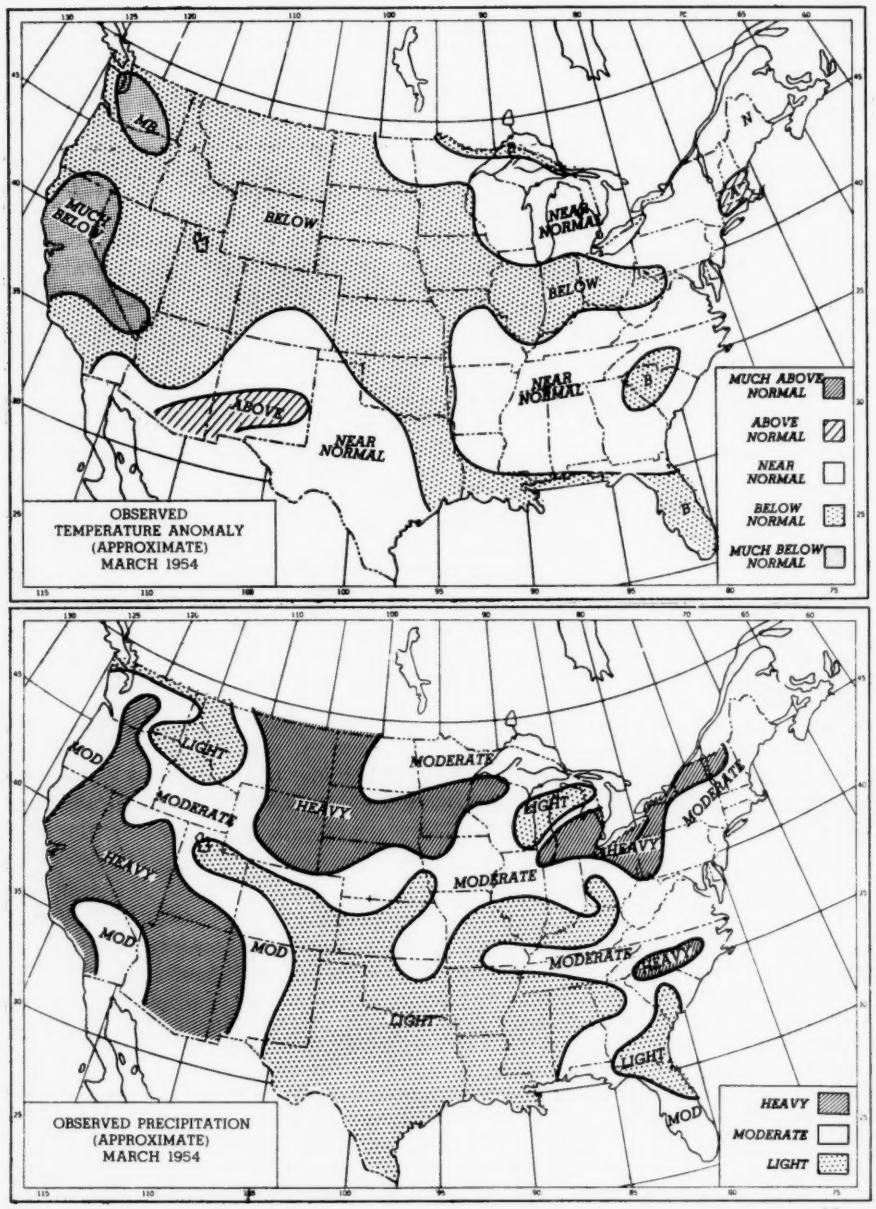
Also, he objects to an editorial change. "On page 249, line 10, the wording of the manuscript, as submitted, was changed from 'a prediction of blight when blight fails to occur' to 'to avoid predicting blight when blight fails to occur.' The meaning was changed, too! In forecasting you do not avoid predicting blight, you predict either it will occur or it will not occur but you never avoid predicting it."

ANNOUNCEMENT: RESULTS OF 1953 FUNGICIDE TESTS

Results of 1953 fungicide tests have been printed in Agricultural Chemicals for January, February, and March 1954.

This is a continuation of the series of reports of the American Phytopathological Society's Special Committee on Testing and Results of Newer Fungicides, hitherto published as supplements to the Plant Disease Reporter.

Reprints of the 1953 reports, at $1.00 each, can be obtained from W. D. Mills, College of Agriculture, Ithaca, New York.



The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.

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